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Great Lakes And Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT / PITTSBURGH DISTRICT

Ohio River Main Stem Systems Study (ORMSS)

Integrated Decision Document and Environmental Assessment:

Ohio River Ecosystem Restoration Program

Appendix A:

Development of Program Goals



Restore,
Enhance &
Protect
Terrestrial
Habitats in
the Ohio
River Corridor



Restore,
Enhance &
Protect
Wetland
Habitats in
the Ohio
River
Corridor



Restore,
Enhance &
Protect
Aquatic
Habitats in
the Ohio
River
Corridor

Draft

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DRAFT Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix A:

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**DEVELOPMENT OF PROGRAM
GOALS**

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DEVELOPMENT OF PROGRAM GOALS, OPPORTUNITIES, AND PURPOSE

A.1 BACKGROUND

As part of the ORMSS study, an interagency, multidisciplinary environmental team was formed to participate in the planning and evaluation of navigation improvement strategies. This team was comprised of natural resources and regulatory experts from Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, and Illinois, as well as representatives from the Corps of Engineers, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency. As the environmental team coalesced, recurrent themes became the extent of ecosystem degradation that remained throughout the Ohio River corridor, despite the significant improvements to some resources over the past 30 years, and the need for a program to deal with remaining current and future problems. Therefore, under the ORMSS, the Corps of Engineers initiated the present study effort to evaluate whether an ecosystem restoration authority specific for the Ohio River was needed.

A.2 HISTORY OF COORDINATION

Coordination with various Federal Agencies and State Resource Agencies has occurred on a regular basis since the beginning of the ORMSS. Since about 1997, interagency environmental team meetings have been held on a quarterly basis. The agencies and Corps Districts have worked together as a partnership in developing a plan for establishing a comprehensive ecosystem restoration program along the Ohio River. The visions and goals for this program and the identified objectives were developed by three interagency committees and approved by all representatives of Federal and State agencies participating in the study.

A.3 STUDY PARTICIPANTS

This feasibility study involved a team consisting of Corps of Engineers staff from three Districts, two consulting firms, five U.S. Fish and Wildlife Service offices, the U.S. Environmental Protection Agency, and six state Departments of Natural Resources and Historic Preservation Officers. The following lists the participants:

- U.S. Army Engineer District, Louisville
- U.S. Army Engineer District, Huntington
- U.S. Army Engineer District, Pittsburgh
- U.S. Environmental Protection Agency
- U.S. Fish & Wildlife Agency Field Offices in:
 - Cookeville, Tennessee
 - Bloomington, Indiana
 - Elkins, West Virginia
 - Reynoldsville, Ohio
 - State College, Pennsylvania
- Ohio River Sanitation Commission (ORSANCO)
- State Natural Resources' agencies:
 - Kentucky Department of Fish & Wildlife Resources
 - Illinois Department of Natural Resources
 - Indiana Department of Natural Resources
 - Indiana Department of Environmental Management
 - Ohio Department of Natural Resources
 - Pennsylvania Department of Natural Resources
 - West Virginia Division of Natural Resources
 - State Historic Preservation Officers
 - Kentucky
 - Illinois
 - Indiana
 - Ohio
 - Pennsylvania
 - West Virginia
- Study Team Environmental Consultants
 - The Mangi Environmental Group, Inc.
 - Parsons Engineering Science, Inc.
 - GEC, Inc.
- Navigation Interests
 - Inland Waterways Users Board (established by Water Resources Development Act of 1986)
 - The Association for Development of Inland in America's Ohio Valley (DINAMO),
Whose Board of Directors include:
 - Secretary, West Virginia Department of Transportation
 - Special Assistant to the Governor, Commonwealth of Kentucky
 - The President of the American Waterways Operators (AWO)
- Other Environmental Interests
 - American Rivers

From the beginning of the study, the environmental team worked together to identify problems and important ecosystem restoration opportunities to benefit the Ohio River corridor. One of the team's first considerations was defining the area of study. The watershed of the Ohio River encompasses over 200,000 square miles. Rather than trying to tackle the entire watershed, the team determined its focus should be on the river and those resources most closely associated

with or most directly interacting with the river. Therefore, the area of study became the Ohio River corridor, which was defined as the mainstem river, tributaries influenced by the river, and the approximate 100 year floodplain. While the 100 year floodplain is defined for each reach of the river, the term “approximate” allows sufficient flexibility to look beyond the precise 100 year elevation as specific situations demand to avoid exclusion of integral ecosystem components.

Over a year was spent in identifying the visions and goals of the partnership. As described below, a comprehensive list of objectives was then developed to focus an ecosystem restoration program on key components of the environment. In so doing, objectives were not constrained so as to fit within existing authorities of any particular agency. The partners envisioned taking a comprehensive approach to solve a variety of problems along the Ohio River corridor.

A.4. DEVELOPMENT OF ECOSYSTEM RESTORATION GOALS

In the early stages of coordination, emphasis was focused on listing the major problems adversely impacting on the Ohio River. Institutional constraints were not considered in developing goals and objectives. It was obvious from the beginning that ecosystem needs were not limited to one aspect of the environment such as aquatic habitat. Therefore, program goals were established to include all aspects of the Ohio River ecosystem, irrespective of institutional constraints that would later come into consideration. The three committees brought recommended goals to the environmental team for discussion. Following discussions, the environmental team agreed upon three broad goals as follows:

- Restore, enhance, and protect wetland habitats along the Ohio River corridor,
- Restore, enhance, and protect important terrestrial habitats adjacent to the Ohio River, and
- Restore, enhance, and protect aquatic habitats within the Ohio River.

A.4.1 Development Of Program Objectives

The environmental team developed categories for the resources and/or issues of greatest concern throughout the Ohio River corridor. These categories were:

- riparian corridors,
- islands,
- floodplains,
- bottomland hardwood forests,
- forested wetlands,
- scrub/shrub and emergent wetlands,
- backwaters,
- aquatic vegetation,

- sand and gravel bars,
- tailwaters,
- pools, and
- side channel/back channel habitats.

The environmental team then focused on ecosystem problems throughout the Ohio River and its associated floodplain. To explore resources in depth, the team organized into three committees to focus on broad resource categories as follows:

- Aquatic problems,
- Terrestrial problems, and
- Wetland problems

In addition, the entire environmental team examined institutional problems affecting ecosystem restoration efforts. They also examined the utility of existing authorities of federal, state, and non-governmental entities to accomplish ecosystem restoration throughout the river corridor.

In the early stages of this study, the three resource area committees attempted to determine the amount of resources lost over the last 100 to 200 years. They then sought to develop reasonable objectives in terms of the amount of resources to be restored within the context of an ecosystem restoration program for the Ohio River.

A.4.2 Aquatic Committee Findings

The aquatic committee looked at islands and back channel areas as well as gravel/sandbars, cobble substrates and tailwaters. At the turn of the 19th century, there were 124 islands, comprising approximately 25,291 acres, in the Ohio River mainstem. Since the 1911-1914 benchmark, 31 islands have been lost completely, and 10,906.4 acres (net loss) of island habitat have disappeared. Presently, there are 93 islands comprising 14,384.6 total acres remaining. Of the 31 islands lost completely, 20 were lost from the upper 300 miles of the Ohio River mainstem.

Island habitats support some of the best remaining natural assemblages of plants and animals native to the river and its floodplain. The often complex interspersions of bottomland and riparian habitats and deep and shallow aquatic habitats make these extremely valuable to numerous fish and wildlife species. The deep and shallow water habitats associated with the islands are major fish and mussel production areas on the Ohio River. Sand, gravel and cobble are predominant at island heads and in some back channels exposed to the thalweg.

The substrate of the river changed as materials eroded from the floodplains and hillsides that were stripped of their native vegetative covers. Backwater areas have become filled with silt since modernization of the navigation system was started. Although, perhaps never a particularly prevalent habitat type in the river, today aquatic vegetation beds are scarce throughout the system. Most of the sand and gravel bars and riffle areas have been lost due to deepening of pools through impoundment and dredging for channel maintenance. Tailwaters now provide the

last vestiges resembling free-flowing riverine habitat and are very important areas for fish spawning and support of native mussel species. Pools are a predominant habitat type, but lack habitat diversity or complexity as compared to riverine reaches. Similarly, side and back channels lack habitat diversity. With the exception of the dam tailwaters, the heads of islands most closely resemble a natural run/riffle habitat.

The aquatic committee concluded that it would be impossible to restore all island resources and gravel/sandbars and cobble substrate. The committee, therefore, discussed achievable amounts of restoration of these resources. The committee concluded that only a portion of the islands could reasonably be restored. It was estimated that up to 40 islands and about 10% of the aquatic habitat, or about 1,250 acres, was a reasonable restoration objective.

A.4.3 Terrestrial Committee Findings

Riparian corridors along the river are very much fragmented, as compared to an almost continuous forested corridor that existed prior to settlement of the floodplain. Intact, forested riparian habitat provides forage and cover for many species, as well as providing important buffer areas from intensive development. The terrestrial habitat committee determined that typical habitat structure historically was a matrix of bottomland forest interspersed with wetlands such as sloughs and oxbows. Much of this habitat was drained and cleared for agriculture, leaving the remainder highly fragmented, although several high-quality natural areas remained. Approximately 1,235,000 acres or 65% of forested floodplain has been converted to other habitat types since 1800.

An analysis was conducted to estimate the amount of forested riparian habitat remaining along the Ohio River mainstem. For this analysis it was assumed that, during the benchmark timeframe of 1800, essentially the entire river corridor was forested encompassing nearly all of the 1,962 linear miles on both banks of the river. Using aerial photography for randomly selected 20 mile stretches of the river, the length of remaining intact forested riparian habitat along each bank was calculated. The percent of forested riparian habitat for each reach was calculated, and then this number was applied to the total number of riparian miles.

Table A-1. Estimate of forest riparian habitat on the banks of the Ohio River mainstem.

District	Total Miles	%Riparian Habitat Remaining	Miles Riparian Habitat Lost
Pittsburgh	254.4	29	180.6
Huntington	621.6	34	410.2
Louisville	1086	62.4	408.3
TOTAL	1962	---	999.1

Due the significant losses of terrestrial habitat, the committee concluded that it would be impossible to restore the entire resource. The committee estimated that 5-10% of the riparian habitat lost was a reasonable target for restoration. This would result in restoration of up to a 100 miles of riparian habitat and about 10,000 acres of bottomland hardwood forest.

A.4.4 Wetland Committee Findings

The Wetland Committee focussed on acres of wetlands that have been lost throughout the Ohio River floodplain. Determining what had been lost helped the committee to establish a reasonable wetland target for the proposed ecosystem restoration program on the Ohio River. Wetlands of all types have been extensively drained and/or filled. The Ohio River Basin Commission's 1970's aerial photography inventory indicated that, within the 946,700 acre Ohio River floodplain, remaining wetlands associated with embayments totaled 13,500 acres and that isolated wetlands totaled 19,500 acres or 2.3% of the floodplain. Based on these numbers, the amount of wetlands lost in the last 100-200 years is at least several hundred thousand acres. Due to large losses, the committee considered using a percent of the acres of wetland lost as the target for wetland restoration. The committee concluded it would be reasonable to restore up to 3% of the wetlands or about 25,000 acres.

Findings and recommendations of the three committees were presented to the full environmental team for review and subsequent approval. As a result of this process, the following objectives were established:

- restore 10,000 acres of bottomland hardwood forests,
- improve 1,250 acres of aquatic habitat,
- restore/protect 40 islands,
- improve 100 miles of shoreline/riparian habitat, and
- restore 25,000 acres of wetlands.

The objectives were developed to address the most critical aspects of the river ecosystem. Clearly, attainment of the objectives would only begin to restore the Ohio River and floodplain ecosystem to a more natural state. Therefore, the program would focus on those areas that would make the most meaningful contribution toward a self-sustaining, more natural environment. Considerations during development of the objectives included:

- creation of habitat benefits for a wide variety of species;
- restoration of historic habitat types that are regionally extirpated, rare, threatened, or declining in abundance;
- coordination with other conservation-based programs (e.g., North American Waterfowl Management Plan, Partners in Flight, etc.), and
- degree of interest in cost sharing to accomplish the objectives.

A.5 REFINEMENT OF RESTORATION OPPORTUNITIES

The next step in addressing the identified objectives was to further define needs of each resource category. Following each problem statement, a list of opportunities are provided to help describe what the partners would hope to accomplish within the context of a comprehensive approach to addressing the Ohio River ecosystem environment. Because of the huge scope of problems and opportunities along the Ohio River, the following represents an initial step in development of a strategic plan to guide implementation of the program if authorized. The opportunities listed help describe what the partners desire to accomplish through an Ohio River Ecosystem Restoration Program. In some cases, participation by the Corps could be limited due to existing law or policy. However, the partnership could strive to find other avenues for implementing needed restoration in those cases. The following sections provide descriptions of problems and opportunities examined.

Problem: Loss/Fragmentation of Riparian Corridors

Because of population growth, industrial development and agricultural use of the floodplain, riparian corridors have been eliminated or reduced in size. Whereas these corridors historically extended well into the floodplain, most are now confined to a narrow band from the top of the riverbank down to the water's edge at best. In most areas there is no longer a continuous corridor of mature riparian vegetation. Rather, the riparian corridor now consists of fragmented sections along portions of the river bank, with little extension into the floodplain.

Opportunity: Restore riparian corridors, reduce fragmentation by expanding and joining isolated habitat blocks and stabilize eroding banks.

Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them.

Conduct threat analyses for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, etc.).

Work with Federal, state, local, and private partners to restore vegetated riparian corridors. In particular, reduce fragmentation by expanding and joining isolated habitat blocks, and stabilize eroding banks.

Problem: Loss of Island Habitat

There are many values and concerns over of islands in the Ohio River. These islands have high environmental value due to the various types of habitat they provide. Many of these islands have significant erosion problems. Island acreage in the Ohio River has decreased by 43 percent or 10,900 acres since 1900. These significant losses have reduced available habitat for endangered species such as Indiana Bats and Interior Least Tern as well as for other species dependent upon the unique habitats associated with the protected back-channels and the heads and toes of islands. Although several islands in the upper part of the river are designated for acquisition and protection as part of the Ohio River Islands National Wildlife Refuge, islands throughout the remainder of the river remain vulnerable. All of the island resources need special attention due to their importance in the ecosystem complex. Much of the following discussion of the national refuge islands is also applicable to other islands throughout the river.

U.S. Fish and Wildlife Service - National Wildlife Refuge Lands

The Ohio River Islands National Wildlife Refuge was established on November 13, 1990. The islands lie within the upper third of the Ohio River, a 362-mile stretch between Shippingport, Pennsylvania, and Manchester, Ohio. These islands range in size from less than 1 acre to nearly 500 acres. The refuge now includes 20 of the 38 islands within the authorized refuge acquisition boundary. Of the 38 islands, 33 are located in West Virginia, with the remaining islands situated in Pennsylvania and Kentucky. The islands consist primarily of 2,200 acres of bottomland hardwood forest (a remnant of the Ohio River floodplain forest of the early 1800's), reverting fields, and agricultural land. Nearly all of the islands have relatively undisturbed back channel areas totaling 1,510 acres.

The interspersed habitats of the Ohio River islands support a diverse assemblage of plants and animals native to the river and its floodplain. The refuge includes significant acreage of underwater habitat which supports important interjurisdictional fish (such as paddlefish and shovelnose sturgeon), 55 other species of warmwater fish, and all of the 45 freshwater mussel species reported to be extant in the upper river (RM 0 to RM 436). Two federally listed endangered mussels (pink mucket and fanshell) are confirmed within the refuge boundary, along with the threatened bald eagle. It is likely that the endangered Indiana bat also occurs within the refuge boundary. A total of 188 bird species (76 of which breed there), 15 species of reptiles and amphibians, and 25 species of mammals have also been identified within the Ohio River Islands National Wildlife Refuge.

Opportunity: Restore, protect existing islands and create islands where they historically occurred.



Picture 1 - Island

Inventory and identify important island habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them.

Conduct threat analysis for high priority island habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, etc.).

Restore existing islands and construct new islands in areas where they historically occurred or where, under current hydrologic conditions, they may be manifested. This may be accomplished in part by the use of dredged materials.

Problem: Conversion of Floodplain Habitat

Most of the Bottomland Hardwood Forests of the Ohio River corridor have been lost or converted to other uses. These areas are critical transitional connections between rarely-flooded, high floodplain habitats and permanently saturated areas along the river. These areas perform numerous ecological functions such as being nutrient sinks and flood attenuation, and play an important role in the hydraulics of adjacent streams. The remaining bottomland hardwood forests need to be preserved and other areas restored where such habitat can be especially beneficial for a given area. Approximately 1,235,000 acres or 65% of the total forested floodplain was lost or converted to other uses between 1800 and 1970. Continued loss of forested areas and loss of connected riparian areas will result in degradation of natural habitats throughout the Ohio River Corridor. Loss of these floodplain forests allows accelerated erosion of materials into the waterways and adversely impacts the hydrologic regime of these streams and floodplain wetlands.

Opportunity: Restore hardwood forests in the 100-year floodplain.

Inventory unique floodplain habitats and those areas with the most intact habitat blocks that warrant protection. Work with partners through conservation easements, acquisition, and land use planning to protect them.

Conduct threat analysis for high priority floodplain habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, drains, etc.).

Work with Federal, state, local, and private partners to reforest as much of the floodplain as possible with native hardwoods, focusing on high priority areas. Reduce fragmentation by expanding and joining isolated habitat blocks.

Problem: Loss of Wetlands

Encroachment and development have caused major losses or damage to wetland areas. These seasonally to permanently saturated areas provide functions similar to those of bottomland hardwood forests, plus provide unique habitats essential to many species. Only relatively small, isolated patches of wetlands remain. Bottomland hardwood wetlands are one of the most crucial habitat types within the Ohio River corridor for many species of fish and wildlife, including state and federally listed species, a number of game species, and important fish species. In particular, bottomland hardwood wetlands provide vital habitat for the copper belly water snake, a species of concern in IL, IN and KY and to the U.S. Fish and Wildlife Service. These very beneficial but limited areas need to be preserved, restored, and expanded. Scrub/shrub and emergent wetlands also provide benefits to fish and wildlife and to humans by helping to maintain water quality through filtration, sediment removal, and fish spawning and food production areas.

Opportunity: Restore Forested Wetlands: Bottomland Hardwoods

Inventory and identify unique bottomland hardwood habitats and those areas with the most intact habitat blocks for protection. Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans, and the Western Hemisphere Shorebird Network Management Plans, as well as state aquatic management plans, to identify high priority areas and goals for maintenance and restoration of bottomland hardwoods. Develop and maintain a GIS database for these areas.

Protect existing high priority bottomland hardwoods through acquisition, conservation easements and other partnerships with conservation groups, industry, private landowners, and citizen watershed groups.

Restore bottomland hardwoods in high priority areas in partnership with Federal and state agencies and private landowners/conservation groups.

Opportunity: Restore Forested Wetlands: Cypress/ Tupelo Swamps and Other Unique Forested Wetlands

Inventory and identify forested wetland habitats and those areas with the most intact habitat blocks that warrant protection. Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans, and the Western Hemisphere Shorebird Network Management Plans, as well as state aquatic management plans, to identify high priority areas and goals for maintenance and restoration of cypress/tupelo swamps and other forested habitats. Develop and maintain a GIS database for these areas including identification of various habitat types.

Protect existing high priority unique habitats through acquisition, conservation easements and other partnerships with conservation groups, industry, private landowners, and citizen watershed groups.

Restore bottomland hardwoods in identified high priority areas in partnership with federal and state agencies and private landowners/conservation groups.

Opportunity: Restore Scrub/Shrub and Emergent Wetlands: including those areas isolated from the river except during high water; and those contiguous with embayments and island sloughs

Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans and Western Hemisphere Shorebird Network Management Plans, as well as state aquatic management plans, to identify high priority areas and goals for maintenance and restoration of emergent and scrub/shrub wetlands. Data on these habitats, as well as other types, will be maintained in the GIS system following an inventory of the resources.

Protect existing high priority scrub/shrub and emergent wetlands in areas with hydric soils in partnership with Federal and state agencies and private landowners/conservation groups.

Construct moist soil impoundments in high priority areas that will provide both emergent and submerged aquatic wetlands and exposed mud/sand flats to benefit a wide variety of wildlife,

including waterfowl, shorebirds, reptiles (such as the copper-belly water snake), fish, and other species.

Develop a mosaic of habitats to provide not only refugia for fish species, but also to provide emergent and scrub/shrub wetlands that function as important migratory bird foraging areas, juvenile fish rearing areas, and other wildlife/fishery values. Provide structure/habitat diversity within the Ohio River for all aquatic species.

Problem: Deterioration of Backwater Habitats

Backwaters, such as embayments, are typically slack water areas that were formed when tributaries connected to the river were permanently flooded by impoundment. These calm, relatively shallow areas have become, to varying degrees, proxies for the natural calm shallow areas (e.g., oxbows) eliminated or degraded by human activities. These areas are also high food production areas and important fish spawning/nursery habitat. They also provide fish refuge from high-velocity flows, particularly during winter. Because of their physical nature (i.e., slack water receiving periodic high suspended solids), many embayments experience high rates of sediment deposition. In some cases, measures are needed to restore embayment habitats from the effects of this deposition. Other slack water areas also need to be restored through various means of habitat improvement, and there are opportunities to create or improve additional areas. Many backwater areas of the Ohio River are silting in, reducing the amount of spawning and nursery areas for various species of fish.

Opportunity: Restore Backwaters (Including Sloughs, Oxbows, Embayments And Bayous)



Picture 2 - Embayment

Identify areas where backwater habitats are limited. Construct backwater areas through the use of off bank revetments, reclamation of abandoned gravel mines, etc.

As much as possible, allow snags to remain in these areas.

Problem: Lack of Aquatic Vegetation

Aquatic vegetation beds have been all but eliminated by development along the river. These areas are of immeasurable regional value to waterfowl feeding and nesting, fish and amphibian reproduction, and to several mammals. Yet, they are among the least available habitats in the Ohio corridor. A comprehensive approach is required to determine where restoration and enhancement of aquatic vegetation could be best accomplished and deliver the most productivity.

Opportunity: Restore riverine submerged and emergent aquatic vegetation

Inventory pools on the Ohio River mainstem to identify those pools with the topography and other features that would allow for establishment of aquatic vegetation beds. Develop and maintain a GIS database for these areas. Work in concert with other user groups to develop and implement an environmental pool management strategy to favor establishment of aquatic plant beds.

Identify areas that could support growth of aquatic vegetation with minor modification of hydrology and/or plantings. These data would be managed via GIS databases. Install structures to modify hydrology in candidate areas to favor establishment of aquatic vegetation, taking precautions to ensure that modifications would not interfere with other uses.

Problem: Loss of Sand And Gravel Bars

Through creation of pools for navigation, dredging, and other activities, there has been a loss of riffles and sand and gravel bars along the Ohio River. As a result, these habitat types, required by various species of freshwater mussels and fish, are seriously limited throughout the mainstem.

Opportunity: Restore and protect Sand and Gravel Bars

Identify areas where sandbars may be enhanced through the addition of gravel or of structures to increase scouring of silt from the gravel beds. Identify areas (i.e., less than 9 feet

deep) that will benefit from adequate current to allow for scouring of sediments to create gravel beds in areas that do not interfere with other authorized uses of the river.

Data related to important sand and gravel bar areas will be entered into existing GIS databases. Existing mechanisms, including the Section 404 and Section 10 permitting processes, provide opportunities to protect important habitat areas. The Corps, EPA, FWS, and States, using existing data, would work with the applicant to avoid these important habitat areas. Other protective measures could include installation of mooring cells or buoys upstream and downstream of locks and other identified problem spots to relieve emergency or impromptu beaching of tows and barges in environmentally sensitive areas.

Problem: Threats To Tailwater Areas of Dams

Tailwaters of locks and dams are a significant riverine habitat. They are important because they serve as important areas for exchange of dissolved gases and provide significant spawning and feeding habitat for several fish species. These areas are also valuable for recreational use because they provide important access areas for fishing. Opportunities for tailwater restoration include modification of hydrology through flow training structures, installation of physical habitat features, measures to improve dissolved gas exchange, etc.

Nineteen tailwater areas below the locks and dams on the Ohio River are the remnants of the important, once widespread, natural riffle and shoal habitat areas for fish and mussels. Initiatives to protect and improve these important remaining areas for fish and to restore habitat lost in other areas of the river are necessary to ensure viable populations of certain species of fish and mussels.

Opportunity: Protect tailwaters and provide structures to provide refuge for fish.



Picture 3 - Tailwater

Protect Habitats in existing tailwaters.

Provide structure, such as parallel dikes, in tailwaters to increase total bottom surface area and provide refuge for fish.

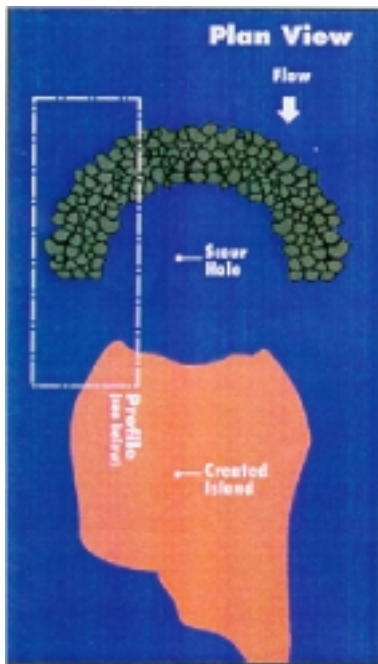
Decrease dangerous currents in those areas to allow safe access for sport fishing activities.

Problem: Lack of Habitat Diversity In Pools

Pools are now the predominant habitat along the river. Through impoundment, their creation has resulted in relatively uniform habitat through most reaches of the river. This lack of habitat complexity results in a decreased diversity of species in many areas of the river by favoring more adaptable species over those less adaptable. This artificial habitat type requires modification and improvement to make it more closely resemble the originally existing, naturally functioning riverine ecosystem.

Opportunity: Create And Protect Fish And Mussel Refuges In Pools (Deep Water; Slow Velocity; Soft Substrate)

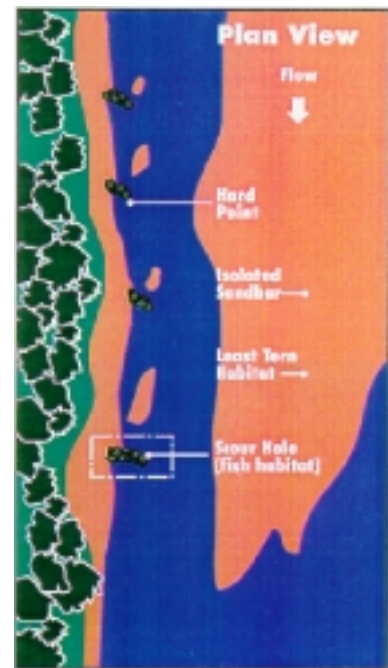
For each pool, identify areas where various structures could be placed that would not conflict with other uses such as navigation. Identify partners for construction and placement of structures and landowners willing to have such structures placed. Potential habitat diversity structures include chevron dikes, off-bank revetments, and side channel hard points. As much as possible allow snags to remain in pool areas. Data would be managed through existing GIS databases for these areas.



Picture 4 – Plan View of a Chevron Dike



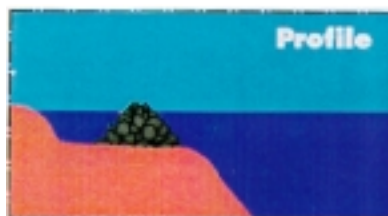
Picture 5 – Plan View of an Off-Bank Revetment



Picture 6 – Plan View of Side Channel Hard Points



Picture 7 – Profile of a Chevron Dike



Picture 8 – Profile of an Off-Bank Revetment



Picture 9 – Profile of Side Channel Hard Points

Problem: Deterioration of Side Channel / Back Channel Habitats

There is currently a lack of habitat diversity in aquatic areas surrounding islands. These habitats are particularly important as refugia for a large number of fish, mussels, and other aquatic life. Measures that could improve these unique habitats need to be implemented to ensure their continued productivity and to further capitalize on their contribution to the ecosystem complex.

Opportunity: Restore and protect aquatic habitat (Side channel/back channel habitat)

Side channel/back channel areas would be inventoried for potential protection, restoration, construction, and enhancement activities. Side channel/back channel habitats are often associated with island habitats. Therefore, activities under this objective would be complimentary with those under objective 2. Protect and enhance existing islands to protect/enhance the associated back channel habitat. Plantings, hard structures and dredged material disposal are some of the activities that could be used to protect islands.

Identify areas where islands previously existed or where new islands could be created to provide valuable back channel habitats without substantial interference with other users. Chevron dikes with dredged material disposal is one method that could be used. Use wing dams and other structures to constrict side channel/back channels to increase velocity and scouring in targeted areas and to provide refugia when needed from the currents. Add structures to these areas such as emergent dikes, artificial reefs, and snags. As much as possible, allow snags to remain in these areas. Data on these habitat types will be managed through existing GIS databases.

Problem: Threat To Other Unique Habitats

At present, not all of the unique habitats along the Ohio River have been identified for protection, and the risk of losing other unique habitats (e.g., canebrakes, river bluff, etc.) is likely in the future. Part of the problem is identifying these habitats and then implementing efforts to protect them in a comprehensive and effective way.

Opportunity: Restore other habitats (e.g., canebrakes, river bluffs, mussel beds, etc.)

Inventory and identify important habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them.

Conduct threat analysis for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, etc.). Restore canebrake habitat as part of the mosaic of habitats in the lower half of the Ohio River ecosystem. Creation of areas conducive to development of these habitats should also be attempted.

Institutional Problems

Existing programs and authorities do not cover all the various types of ecosystem restoration measures needed along the Ohio River corridor. There is no comprehensive program that would require consideration and treatment of ecological problems and opportunities in an over-arching manner based on ecological priorities. Section 1135 offers only limited opportunity for projects due to the relatively small amount of Corps lands and easements along the Ohio River. Section 206 cannot be used to address many of the area's ecosystem problems outside the aquatic environment *per se*. Projects implemented under the 206 and 1135 programs, as well as other federal and nonfederal programs are piecemeal at best, and sources of funds are very limited. Further, existing cost sharing requirements are not attractive to most potential non-Federal sponsors that border the Ohio River. In some cases sponsors have felt it has taken too long to get projects approved under existing authorities, and the process for approval has been inefficient in the past. Other institutional problems include limited funds at the state or local level and the limited types of projects applicable under existing authorities. Finally, there is no current coordinated program for the Ohio River corridor that states and other potential sponsors can focus on in a holistic, coordinated manner.

A.6 DEVELOPMENT OF EXAMPLE PROJECTS

Translating the above opportunities into actions required the environmental team to undertake a process of identifying, developing, and evaluating certain specific projects as examples of individual actions that could be undertaken. This was done to ensure the actions would contribute to attainment of the objectives, as well as to make preliminary determinations of the scope, costs, and benefits of individual actions that may be implemented under an ecosystem restoration program. The team identified over 250 potential site-specific projects within the Ohio River corridor for possible implementation. The following table provides a general listing of the variety of projects envisioned for implementation by the partnership.

TABLE A-2

GENERAL PROJECT TYPES	HABITAT CREATED/PROTECTED/RESTORED
Chevron Dikes	Create avian nesting and feeding habitat, increase aquatic habitat diversity for fish and benthos
Off Bank Revetments	Create aquatic habitat diversity, and provide shelter during winter flows, provide structure for increased offshore fishing, facilitate development of a sustained, diverse fishery resource.

Side Channel Hardpoints	Increase aquatic habitat diversity for fish and benthos
Island Creation	Create off-channel habitat, increase aquatic habitat diversity and increase fish spawning habitat, create terrestrial and riparian habitat and wetland habitat. Benefit endangered species
Embayment Restoration	Deepen silted embayments, enhance access for fish, increase deepwater aquatic habitat diversity and improve fish spawning habitat, provide over-wintering habitat for various fish species.
Stream Shoreline Restoration	Improve riparian habitat for wildlife, reduces soil erosion, provided aquatic habitat diversity
Backwater Area Restoration	Provide reproductive, feeding, nursery, feeding and over-wintering habitat for riverine fish and provide habitat for migratory waterfowl, wading birds and other wildlife.

A.7 NEED FOR AN ECOSYSTEM RESTORATION PROGRAM

The Ohio River ecosystem was historically a free-flowing river through primarily forested habitat, with scattered prairies, canebrakes, and wetlands in the floodplains of the river and its tributaries. Most of this area has been settled, cleared, drained, farmed, and developed, resulting in loss of essential habitats, and fragmentation of many of those habitats that remain. Canalization of the Ohio River has also altered the ecology of the riparian corridor. These changes have affected both the abundance and diversity of habitats and wildlife, with the result of favoring more common species and exacerbating the decline of less tolerant or less adaptable species. Loss of riparian habitat in particular affects not only wildlife but also water quality and hydrology in adjacent waterways. Islands in the river contain some of the most natural riparian and bottomland forest habitats remaining. Modifications to the river itself, particularly impoundment, have dramatically altered the natural process of island accretion and degradation. While many islands were covered with water, others have been removed by dredging or through other actions. There are relatively few areas in the corridor managed for resource conservation, and there is a general lack of land use planning and zoning.

Examination of the problems and opportunities throughout the Ohio River and floodplain by the environmental team resulted in their determination that a comprehensive ecosystem restoration program was needed for the Ohio River corridor. Many pervasive problems still exist throughout the area, and these are not being addressed under existing authorities. An over-arching program with a strategic view of the entire resource base is

needed to develop a plan and prioritize efforts among the variety of interests along the river.

A.7 Program Purpose

The purposes of an Ohio River Ecosystem Restoration program would be:

- To establish an interagency partnership which focuses on a comprehensive approach to ecosystem restoration throughout the Ohio River corridor,
- To develop a strategic plan that further refines and prioritizes needs for ecosystem restoration initiatives along the Ohio River corridor,
- To develop and evaluate measures for implementation that would address the needs identified above, and
- To implement measures that contribute to meeting ecosystem restoration objectives.



US Army Corps
of Engineers
GREAT LAKES AND OHIO RIVER DIVISION

LOUISVILLE DISTRICT / HUNTINGTON DISTRICT / PITTSBURGH DISTRICT

Ohio River Main Stem Systems Study (ORMSS)

Integrated Decision Document and Environmental Assessment:

Ohio River Ecosystem Restoration Program

Appendix B:

SOCIO-ECONOMIC APPENDIX



Restore,
Enhance &
Protect
Terrestrial
Habitats in the
Ohio River
Corridor



Restore,
Enhance &
Protect
Wetland
Habitats in
the Ohio
River
Corridor



Restore,
Enhance &
Protect
Aquatic
Habitats in
the Ohio
River
Corridor

DRAFT

August 2000



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program **ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA,** **PENNSYLVANIA**

Appendix B:

SOCIO-ECONOMIC APPENDIX

August 2000

OHIO RIVER MAINSTEM SYSTEMS STUDY
Ohio River Ecosystem Restoration Program

APPENDIX B: **SOCIO-ECONOMIC APPENDIX**

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POPULATION, HOUSING, & EDUCATION

POPULATION BY STATE

Historical population estimates as well as future population projections for these states are shown in Table B-1. All states' populations are expected to increase over the next 25 years with the exception being West Virginia. West Virginia's population shows a projected decline of -0.32 percent from 2015 to 2025. From the data the biggest increase for each state was from 1990-1995.

TABLE B-1 POPULATION BY STATE							
State	1900 (x1000)	1990 (x 1000)	1995 (x 1000)	2000 (x 1000)	2005 (x 1000)	2015 (x 1000)	2025 (x 1000)
Illinois	4,828	11,431	11,830	12,051	12,266	12,808	13,440
Indiana	2,518	5,544	5,803	6,045	6,215	6,404	6,546
Kentucky	2,148	3,687	3,860	3,995	4,098	4,231	4,314
Ohio	4,161	10,847	11,151	11,319	11,428	11,588	11,744
Pennsylvania	6,313	11,883	12,072	12,202	12,281	12,449	12,683
Tennessee	2,023	4,877	5,431	5,657	5,966	6,365	6,665
West Virginia	959	1,793	1,828	1,841	1,849	1,851	1,845

Source: US Census Bureau

POPULATION BY MSA/COUNTY

The major metropolitan statistical areas (MSA) or counties from these areas are shown below in Table B-2. From this data it appears that the Nashville, Tennessee MSA has the highest percentage of growth from 1990-2010 at 39.7%, followed by the Cincinnati and Columbus, Ohio MSAs at 38.8% and 22.7% respectively. Most of the other counties or MSA's have some growth expected as well, but not to the extent of Nashville, Cincinnati, or Columbus. It is to be noted that Allegheny County, Pennsylvania (the county that Pittsburgh is located in) has a projected decrease in population. This could be due to the fact that more people are moving out of the county and into the suburbs.

TABLE B-2 POPULATION BY MSA OR COUNTY				
MSA or County	1900	1990	2000	2010
Allegheny Co., PA (Pittsburgh)	775,058	1,336,449	1,265,184	1,187,725
Kanawha Co., WV (Charleston)	not available	207,619	205,115	205,690
Cincinnati, OH Metropolitan Area	not available	1,526,090	1,970,100	2,118,700
Jefferson Co., KY (Louisville)	232,549	665,123	669,722	669,421
Vanderburgh Co., IN (Evansville)	71,769	165,058	168,464	170,933
McCracken Co., KY (Paducah)	28,534	62,879	64,865	65,004
Marion Co., IN (Indianapolis)	197,227	797,159	823,173	837,599
Columbus, OH Metropolitan Area	not available	1,345,450	1,507,200	1,651,300
Dayton, OH Metropolitan Area	not available	951,270	984,900	1,009,400
Nashville, TN Metropolitan Area	289,369	985,026	1,190,224	1,375,740
Alexander Co., IL (Cairo)	19,384	10,626	10,634	10,235
Massac Co., IL (Metropolis)	13,110	14,752	15,454	15,866
Cabell Co., WV (Huntington)	not available	96,827	97,332	100,966

Source: US Census Bureau's State Data Centers

HOUSING

Table B-3 is a tabulation of the number of total housing units and persons per household for each state for the years 1980, 1990 and 1998. This table also contains a listing of the homeowner and rental vacancy rates for 1990 for each state.

TABLE B-3 POPULATION AND HOUSING							
	Illinois	Indiana	Kentucky	Ohio	Pennsylvania	Tennessee	West Virginia
Total Housing Units, 1980	4,319,720	2,091,796	1,368,811	4,108,090	4,596,743	1,747,390	747,993
Total Housing Units, 1990	4,506,275	2,246,046	1,506,845	4,371,945	4,938,140	2,026,067	781,295
Total Housing Units, 1998	4,776,992	2,502,753	1,663,975	4,681,506	5,228,921	2,318,069	794,481
Homeowner Vacancy Rate, 1990	1.5	1.5	1.6	1.3	1.5	2.1	2.2
Rental Vacancy Rate, 1990	8.0	8.3	8.2	7.5	7.2	9.6	10.1
Persons per household, 1990	2.65	2.61	2.6	2.59	2.57	2.52	2.55
Persons per household, 1998	2.65	2.57	2.56	2.55	2.54	2.56	2.48

EDUCATION

Table B-4 shows the education statistics for each state for the year 1990. This table shows the enrollment for elementary and high school, the percentage in private schools, and the percentage of high school and college graduates for each state.

TABLE B-4 EDUCATION, 1990							
	Illinois	Indiana	Kentucky	Ohio	Pennsylvania	Tennessee	West Virginia
Elementary and high school enrollment	1,951,184	974,985	655,831	1,880,830	1,848,689	821,881	317,541
Percent in Private School	13.8	8.8	8.6	11.8	16.1	7.3	4.1
Persons age 25 years and over	7,293,930	3,489,470	2,333,833	6,924,764	7,872,932	3,139,066	1,171,766
Percent High School Graduates	76.2	75.6	64.6	75.7	74.7	67.1	66.0
Percent College Graduates	21.0	15.6	13.6	17.0	17.9	16.0	12.3

Source: US Census Bureau

LABOR FORCE, EMPLOYMENT, AND ECONOMY

LABOR FORCE

Extensive coal deposits, abundant limestone reserves, fertile soils, abundant water supplies, and extensive woodlands are the area's principal resources. These resources, along with less extensive deposits of crude oil, natural gas, glass sands, clays, and minerals such as salt, zinc and copper, supported initial settlement of the area and the development of its first industries—coal mining, farming, chemical manufacture, meat packing, glass making, pottery, petroleum refining, and steel manufacturing. Some of these are still major industries in the region, most notably the steel, chemical, and coal mining industries.

Though diversified, the economy of the basin is not geographically of one character. In the Ohio River Basin's major cities the economy is robust and diversified, depending upon services and technology, and much less on manufacturing. The smaller cities still rely heavily upon manufacturing (especially steel, automobile and aluminum production), while the hinterlands are still heavily dependent upon extractive industries (especially coal mining) and farming. The regional sectors of highest importance to waterway traffic are coal mining and their primary customer, electric utilities; stone quarrying and construction; farming; and manufacturing.

Table B-1 shows the labor force for, and the percent change for each state. From the data shown, it appears that Tennessee and Kentucky have the highest percentage of growth in the labor force at 38.2 and 22.6 percent, respectively and West Virginia has the lowest percentage of growth at 5.7 percent.

TABLE B-1 LABOR FORCE				
State	1979	1989	1999	% Change 1979-1999
Illinois	5,437,429	6,014,941	6,385,148	17.4
Indiana	2,630,148	2,880,037	3,077,507	17.0
Kentucky	1,606,423	1,741,681	1,969,589	22.6
Ohio	5,058,933	5,418,155	5,748,616	13.6
Pennsylvania	5,360,993	5,856,098	5,969,084	11.3
Tennessee	2,039,031	2,367,873	2,818,807	38.2
West Virginia	773,094	767,035	817,014	5.7

Source: US Bureau of Labor Statistics

UNEMPLOYMENT RATE

The unemployment rates for each state are listed below in Table B-2. Indiana and Pennsylvania have the highest decreases in the unemployment rate at 52.6 and 36.7 percent, respectively. West Virginia has the lowest decrease in the unemployment rate at 2.2 percent.

TABLE B-2 UNEMPLOYMENT RATES				
State	1979	1989	1999	% Change 1979-1999
Illinois	5.52	5.99	4.28	-22.5
Indiana	6.39	4.73	3.03	-52.6
Kentucky	5.57	6.18	4.48	-19.6
Ohio	5.92	5.54	4.27	-27.9
Pennsylvania	6.93	4.52	4.39	-36.7
Tennessee	5.79	5.11	4.03	-30.4
West Virginia	6.74	8.62	6.59	-2.2

Source: US Bureau of Labor Statistics

NON-AGRICULTURAL EMPLOYMENT

Table B-3 is a listing of the number of non-farm establishments in each state. Illinois and Pennsylvania have the largest number at 251,561 and 247,897 respectively with West Virginia and Kentucky having the smallest number at 33,861 and 72,305 respectively. This table also lists the percentage of these establishments that are retail-oriented as well as the percentage that are service-oriented. West Virginia and Kentucky have the highest percentage of retail-oriented establishments, but also the lowest percentage of service-oriented establishments. Illinois and Pennsylvania have the largest percentage of trade-oriented services. Ohio and Indiana have the lowest percentage of retail-oriented services.

TABLE B-3 NON FARM ESTABLISHMENTS, 1992			
State	Number of Establishments	Percent Retail Trade	Percent Services
Illinois	251,561	25.8	31.7
Indiana	117,659	28.4	29.3
Kentucky	72,305	30.6	29.0
Ohio	226,058	28.2	30.9
Pennsylvania	247,897	28.9	31.4
Tennessee	103,589	29.5	30.8
West Virginia	33,861	40.0	28.0

Source: US Census Bureau

Table B-4 shows the breakdown of non-agricultural employment, by field, for each state.

TABLE B-4 NONAGRICULTURAL EMPLOYMENT, 1992							
State → Sector ↓	Illinois	Indiana	Kentucky	Ohio	Pennsylvania	Tennessee	West Virginia
Mining	858	426	1,140	1,022	1,219	291	1,163
Construction	24,579	13,124	7,337	23,352	26,222	9,270	3,595
Manufacturing	18,779	9,278	4,307	18,282	18,089	7,608	1,783
Transportation	9,609	4,151	2,949	7,072	7,888	3,606	1,350
Communications	1,606	887	658	1,362	1,592	806	383
Utilities	618	453	419	588	888	246	269
Wholesale	24,637	10,264	5,931	19,305	20,230	9,341	2,427
Retail	64,826	33,448	22,091	63,701	71,652	30,582	10,480
Services	79,791	34,503	20,973	69,909	77,839	31,953	9,496
Finance	8,301	3,756	2,281	7,392	8,167	3,618	868
Insurance	8,192	3,720	2,165	7,075	6,882	3,098	931
Real Estate	9,765	3,649	2,054	6,998	7,229	3,170	1,116
All	251,561	117,659	72,305	226,058	247,897	103,589	33,861

Source: US Census Bureau

INCOME AND POVERTY

Table B-5 lists the median household income, per capita income, and percent of population below the poverty level for the years 1990 and 1998 for each of the states listed. It can be noted that Illinois has both the highest median household and per capita incomes for 1990 and 1998, while West Virginia has the lowest median household and per capita incomes in 1990 and 1998. It can also be noted that West Virginia has the highest percentage of people below the

poverty level for both 1990 and 1998. Ohio has the lowest percentage of people below the poverty level in 1990 while Indiana has the lowest percentage of people below the poverty level for the year 1998.

TABLE B-5 INCOME AND POVERTY							
	Illinois	Indiana	Kentucky	Ohio	Pennsylvania	Tennessee	West Virginia
Median Household Income, 1990	\$40,584	\$33,583	\$30,904	\$37,430	\$36,173	\$28,175	\$27,608
Median Household Income, 1998	\$43,178	\$39,731	\$36,252	\$38,925	\$39,015	\$34,091	\$26,704
Per Capita Income, 1990	\$22,058	\$18,477	\$16,236	\$19,498	\$20,849	\$17,554	\$15,258
Per Capita Income, 1998	\$25,619	\$21,490	\$19,083	\$22,302	\$23,733	\$20,904	\$17,180
Percent population below poverty level, 1990	13.7	13.0	17.3	11.5	11.0	16.9	18.1
Percent population below poverty level, 1998	10.1	9.4	13.5	11.2	11.2	13.4	17.8

Source: US Census Bureau

INFRASTRUCTURE

The Ohio River Basin is comprised of 7 states; Illinois, Indiana, Kentucky, Ohio, Pennsylvania, Tennessee, and West Virginia. It is a rectangular-shaped area roughly bounded on the east by the Allegheny Mountains, on the west by the Mississippi River, on the north by the Great Lakes, and on the south by the Tennessee River. The Ohio River bisects the study area in a northeast to southwest direction. The eastern portion of the study area is characterized as generally mountainous, giving way to eroded uplands with vast reserves of coal. The western area is characterized as generally rolling terrain, which gives way to the eastern prairie lands of Illinois.

These states involved in the Ohio River Basin have varying temperatures throughout the year. In general, the temperatures are warmest from June-August and coldest from December-February.

CITIES AND TOWNS ALONG THE OHIO RIVER

Table B-1 shows a listing of the cities along the river for each state.

TABLE B-1 CITIES & TOWNS ALONG THE OHIO RIVER				
Illinois				
Cairo	Metropolis	Bay City	Elizabethtown	Rosiclare
Mound City	New Grand Chain	Karnak	New Liberty	Joppa
Brookport	Old Shawneetown	Cave in Rock	Olmsted	Hamlettsburg
Unionville	Shawneetown	Golconda		
Indiana				
Hovey	Rockport	Derby	Owen	Florence
Mt Vernon	Grandview	Dexter	Bethlehem	Patriot
West Franklin	Maxville	Magnet	Old Otto	North Landing
Rahm	Troy	Alton	New Otto	Rising Sun
Cypress	Tell City	Evans Landing	Paynesville	French
Vaughan	Cannelton	Bridgeport	Saluda	Aurora
Evansville	Rocky Point	Clarksville	Hanover	Lawrenceburg
Newburgh	Dodd	New Albany	Madison	Enterprise
Yankeetown	Tobinsport	Jeffersonville	Brooksbury	Markland
Eureka	Lauer	Utica	Vevay	Lamb
Rome	Charlestown			

Kentucky				
Wickliffe	Alzey	Brandenburg	Idlewild	Garrison
Monkey's Eyebrow	Geneva	West Point	Covington	Quincy
Ragland	Henderson	Kosmosdale	Newport	St Paul
Rossington	Newman	Louisville	Fort Thomas	Firebrick
Grandville	Stanley	Prospect	Oneonta	South Portsmouth
Maxon	Owensboro	Westport	Foster	Raceland
Paducah	Hawesville	Milton	Bradford	Russell
Ledbetter	Maceo	Carrolton	Augusta	Bellefonte
Smithland	Thruston	Ghent	Dover	Ashland
Birdsville	Lewisport	Etheridge	Maysville	Catlettsburg
Bayou	Cloverport	Warsaw	Springdale	Caseyville
Carsville	Holt	Beaverlick	Trinity	Wolf Creek
Stephensport	Tolu	Rabbit Hash	DeKoven	Petersburg
Fords Ferry	Ammons	Concord	Battletown	Wurtland
Mooleyville	Bellevue	Uniontown	Southshore	Mentor
Burlington	Clarksburg	California	Greenup	Skylight
Vanceburg				
Ohio				
Cleves	Wheelersburg	Middleport	Fly	Knoxville
Addyston	Franklin Furnace	Pomeroy	Sardis	Empire
Cincinnati	New Richmond	Minersville	Duffy	Stratton
Haverhill	Hanging Rock	Syracuse	Hannibal	Port Homer
Point Pleasant	Russel	Racine	Clarrington	Powhatan Point
Moscow	Ironton	Antiquity	Letart Falls	Dilles Bottom
Neville	Coal Grove	South Point	Apple Grove	Shadyside
Chilo	Utopia	Burlington	Portland	Aberdeen
Wellsville	Higginsport	Ceredo	Bellaire	Proctorville
East Liverpool	Levanna	Long Bottom	Manchester	Little Hocking
Ripley	Sybene	Bridgeport	Athalia	Yorkville
Chesapeake	Reedsville	Wrightsville	Belpre	Friendship
Hockingport	Brookside	Miller	Tiltonsville	Kanauga
Martins Ferry	Rome	Constitution	Portsmouth	Newport
Buena Vista	Crown City	Rayland	Addison	Sciotoville
Gallipolis	Marietta	New Boston	Georges Run	Hobson
Reno	Bush Run	Beavertown	Mingo Junction	New Matamoras
Brilliant	Cheshire	Grandview	Steubenville	Toronto

Pennsylvania				
Georgetown	Vanport	Freedom	Baden	Sewickley
Midland	Monaca	Conway	Ambridge	Coraopolis
Shippingport	Beaver	Aliquippa	South Heights	Pittsburgh
West Virginia				
Kenova	Mason	Vienna	Proctor	Weirton
Ceredo	New Haven	Boaz	Natrium	Cumberland
Chesapeake	Graham Station	Williamstown	Captain	Chester
Huntington	Hartford	Waverly	McKeffrey	Glen Dale
Proctorville	Mt Alto	Willow Island	Moundsville	Raven Rock
Lesage	Cottageville	Belmot	Saint Marys	Newell
Clover	Millwood	Sherman	Muses Bottom	Parkersburg
Glenwood	Silverton	Point Pleasant	Triadelphia	Sistersville
Ashton	Gallipolis Ferry	Bend Run	Short Creek	McMechen
Apple Grove	Belleville	Friendly	Wellsburg	Follansbee
Lakin	Eli	Paden City	Wheeling	Washington
Clinton	New Martinsville			

TRANSPORTATION

Highways: The states in the Ohio River basin are served by a number of state and Interstate highways. These highways make up a very efficient and widely used system of transportation.

Air and air cargo: Several Major airports serve the states in the Ohio River Basin as well as numerous smaller airports. These airports provide service from most major airlines.

Rail: Rail transport to the entire United States is available in all of the states in the Ohio River Basin. Many major railroad companies service the 7-state area.

Truck: All states in the 7-state area are served by numerous over-the-road-trucking lines.

RIVERFRONT DEVELOPMENT

Along the Ohio River, several cities are involved in making developments along the river. These riverfront development projects are listed below organized by state.

Indiana

Ohio River Greenway. The Greenway consists of a corridor 7 miles in length, designed to provide access to the Ohio River and its environmental and recreation amenities. Access would be provided by a parkway, pedestrian and bicycle pathways, interpretive areas, passive recreation areas and trails and it would integrate the existing and planned riverside development including the Falls of the Ohio State Park and interpretive center/museum, the National Wildlife Conservation Area, and other federal and local river related facilities. Congressional appropriation adds in Fiscal Years 93, 95, 96 and 97 provided funds to the Corps to prepare a master plan for the Greenway and to develop design documents.

Accomplishments to date include: development of a master plan for the entire area, schematic design, a Design Guidelines Manual, detailed design and construction documents for three pilot project areas, a HTRW assessment for the entire area, and an environmental baseline study for the entire area. WRDA 96 provided conditional authorization for the Ohio River Greenway predicated on approval by the ASA (CW) of the project's feasibility. In response to this authorization, the Louisville District forwarded a report on the Greenway to HQ in February 1998. Potential local sponsors include the communities of Jeffersonville, Clarksville, and New Albany and the Ohio River Greenway Commission, which was created by the Indiana legislature for the express purpose of cooperating with other agencies to implement the Greenway. All four communities have provided Letter of Intent.

Kentucky

Riverfront Development Project, Owensboro. The city of Owensboro has prepared a preliminary concept plan for the riverfront development project.

WaterFront Park Phase 1, Louisville. The City of Louisville is currently developing Waterfront Park. A decade-long renovation of Louisville's waterfront has replaced former scrapyards and industrial sites with green hillocks, playgrounds, fountains and an expansive "Great Lawn." A 13,000-seat baseball stadium, Louisville Slugger Field, adjacent to Waterfront Park opened in April of 2000. This stadium is adjacent to the Great Lawn that was completed in 1998. The Great Lawn has been used for various concerts and festivals throughout the spring, summer, and fall.

WaterFront Park Phase 2, Louisville. Waterfront Park Phase 2 will continue to build on the success of Phase 1. Phase 2 will add 34 additional acres of Linear Park to the east of Phase 1. The centerpiece of Phase 2 will be a pedestrian connection to the Big Four Bridge, which will help complete a loop along Louisville's waterfront and Indiana's planned Greenway project. This phase also includes a much larger play area for children, spraying fountains for water play; and

informal amphitheater, a café, a nature preserve on Towhead Island, a rowing facility in conjunction with the University of Louisville Rowing Club, additional parking areas off of River Road, a continuation of walking paths, and additional picnic areas, meadows, tree groves, and native plantings.

Waterfront Development, Covington. The City of Covington has created a preliminary master plan for waterfront development along the Ohio River, directly across from the proposed Cincinnati riverfront development project. The first phase of the project will consist of removal of the existing earthen levee, construction of 1200 lineal feet of new concrete floodwall, three new floodgates, new pumping station, utility infrastructure, and brownfields environmental restoration. The preliminary cost estimate for the construction is \$10 million. Future project phases will consist of landscaping and development of a riverwalk to connect this area to Covington Landing. The project is located in close proximity to the proposed Cincinnati riverfront development, "The Banks", which includes new riverfront stadiums, parks, and residential development. Riverfront projects on both banks of the river will draw increased visitation to both areas. The primary purpose of this project is to enhance public access to the amenities of the Ohio River in the vicinity of the flood control levee in Covington. The local flood protection project continues to serve its function, however, it cuts off the city of Covington and provides them with limited access for operation and maintenance of the facilities. If constructed today, the project would provide the community opportunities to operate and maintain the existing flood control facilities more efficiently and provide better access to the Ohio River.

Ohio

The Banks, Cincinnati. This proposed riverfront development project will re-establish the city grid to the river, transform existing isolated parks into a riverfront parks system, and preserves the view from downtown to the river and from the river to downtown. This project will be in conjunction with the construction of new stadiums for the Major League Baseball's Reds and the National Football League's Bengals. This project is also planning to add centrally located parking, link attractions to the downtown retail/office core, construct a light rail transport system linking nearby communities, as well as the northern Kentucky Area.

West Virginia

Wheeling Waterfront Development. Potential waterfront redevelopment could include flood damage reduction, streambank protection, aquatic ecosystem restoration in Wheeling Creek, and navigation (boat landing) facilities, any of which are supportable under executive branch policy. \$100,000 will be utilized to perform a study in conjunction with the Wheeling National Heritage Area Corporation and the City of Wheeling, WV to determine future Corps involvement in the Wheeling National Heritage Port Project

Monongahela River, Riverfront Development. 1997 Energy and Water Development Appropriations Act requested \$500,000 for the Corps of Engineers to initiate preconstruction

engineering and design activities at the Palatine Park, Pricketts Fort, Morgantown and Rails to Trails Corridor sites. Three sponsors have shared costs at this time including the City of Morgantown for the Morgantown Riverfront Park, Region IV Planning and Development Council for the Caperton Rail to Trail, and the City of Fairmont for Palatine Park. Additional PED funding had been provided for the overall effort. Negotiations have been reinitiated with the Pricketts Fort Foundation to discuss the Pricketts Fort site. Negotiations continue at this time. In addition, negotiations are underway with the City of Fairmont concerning the expansion of the Palatine Park effort.

CONCLUSIONS

The Ohio River study reflects a section of the United States that has undergone many changes over the years. The socio-economic vitality of this area is based on a mix of both rural and urban uses. The basin is rich in natural resources and served by a transportation system that has allowed for extensive economic development. In summary, the principal resources are fertile soils, extensive forests, abundant water supplies, and large deposits of coal. The Area is served by all modes of transportation, but with the unique regional advantage of the Ohio River, which bisects the basin. As a result, the area has a robust and diversified economy. The ecosystem restoration projects would help to preserve and enhance the Ohio River corridor.

REFERENCES

OHIO RIVER ECOSYSTEM RESTORATION

List of References

City of Cincinnati's Web Site
City of Louisville's Web Site
Covington, Kentucky Waterfront Development Project Fact Sheet
Monongahela River Waterfront Development Project Fact Sheet
Ohio River Greenway, Indiana Project Fact Sheet
Rand McNally Road Atlas
United States Bureau of Labor Statistics
United States Census Bureau's Web Site
Waterfront Park, Louisville, Kentucky Project Fact Sheet
Wheeling, West Virginia Waterfront Development Project Fact Sheet



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Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix C: Environmental Resources

August 2000

Ohio River Ecosystem Restoration Program
ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix C:

ENVIRONMENTAL RESOURCES

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ENVIRONMENTAL RESOURCES

C.1. INTRODUCTION

The purpose of describing the environmental setting in a report such as this is to provide a description of existing conditions in the project area. Information provided could then be used as background data to evaluate the impacts any action will have on the present environment.

Topics discussed include all major aspects of the Ohio River ecosystem and its relationship to man's activities and the environment. These topics, by nature, tend to be extremely varied. Where possible, discussions are limited to the immediate vicinity of the navigation system; but in some disciplines, such as geology and economics, it is more appropriate to speak of basin-wide or even region-wide relationships. Therefore, some information cited in the various sections which follow will stem from sources on the fringes of or even outside of the basin itself.

C.2. GEOGRAPHY

The Ohio River Basin, which contains a total area of 203,910 square miles, lies in the middle eastern portion of the United States. The river supplies the largest volume of flow of the six Mississippi natural tributary drainage patterns, and of these, only the Missouri River Basin exceeds the basin in land area. The study area, some 300 miles wide and 981 miles long, is bounded on the north by the Great Lakes drainage basin, on the east by the divide of the Appalachian Mountains, on the south by the Gulf of Mexico and southeast coastal drainage basins, and on the west by tributary drainage areas of the Upper Mississippi River. The drainage area represents about 6 percent of the total for the 48 contiguous states and nearly 25 percent of that east of the Mississippi River.

The Ohio River Basin's geographic location and its natural resources have been a major factor in the economic growth of the basin and the Nation. The dominant influences during the socioeconomic growth of the region were rich soils, favorable climate, dense forests, and the rivers as arteries of transport. Later, mineral resources, especially coal, became important in molding the industrial complexes. Rugged terrain and inaccessibility of large areas in the Appalachian Plateau have retarded economic growth of large portions of the region and the basin.

The Ohio River provides the backbone of the water transportation system. The basin economy is related to the mineral resources and is associated with manufacturing and power industries. The location of much of the coal production is in the rugged terrain of the Allegheny, Monongahela, and major southern tributaries. The transportation system has important

extensions on and along these rivers. About one-third of the entire basin economy is within the counties and areas bordering the Ohio River and tributary navigable waterways.

C.3. PHYSIOGRAPHY

The Ohio River flows through four physiographic provinces. The river begins on the Appalachian Plateau, proceeds through the northern part of the Interior Low Plateau where it serves in some places as the boundary between the Interior Low Plateau and the Central Lowlands, then enters the Coastal Plain where it converges with the Mississippi River. In the following paragraphs, the provinces and their sections are described as they are encountered along the Ohio River from Pittsburgh, Pennsylvania, to Cairo, Illinois.

The upper reach of the Ohio River from Pittsburgh, Pennsylvania (River Mile 0) to approximately Vanceburg, Kentucky (River Mile 380), flows through the Kanawha Section of the Appalachian Plateau Province. In this section, the Appalachian Plateau exhibits moderate to strong relief due to erosion of the uplifted plateau. The relief becomes more rugged to the south and east of the river but remains essentially uniform along the river. The Ohio River is in a mature stage here which is evidenced by a well-developed alluvial flood plain, numerous meanders, and the fact that its present course is superimposed on an earlier cut channel. Although the Ohio River Valley portion of the Appalachian Plateau region was not glaciated during the Pleistocene Epoch, the presence of glaciers in the northern portion of the basin drastically changed the pre-Pleistocene drainage and was directly responsible for the course of the Ohio River today. The features resulting from glacially induced drainage changes include remnant valleys and abandoned riverbeds, as seen in the Teays and Marietta Rivers, as well as flood plain terraces. The terraces are local features which vary greatly in their development. They indicate at least three separate cycles of rejuvenation caused by regional uplift. Many of the main tributaries of the Ohio River also have well-developed flood plains and remnant terraces. Small tributaries along the Ohio River exhibit dendritic stream patterns with most tributaries upstream of New Martinsville, West Virginia (River Mile 130), entering the river at angles pointing upstream. The flood plain is narrow upstream (0.8 miles at Pittsburgh) and broadens downstream to 1.6 miles at Vanceburg. Approximately 39 percent of the Ohio River Valley is located within the Kanawha Section of the Appalachian Plateau.

Downstream of the Appalachian Plateau Province, the Lexington Plain Section of the Interior Low Plateau Physiographic Province is encountered at approximately Vanceburg, Kentucky (River Mile 380), and extends nearly to the Salt River in Kentucky (River Mile 630). The major portion of this section along the Ohio River Valley is bordered on the north (Ohio) side by the Till Plains Section of the Central Lowlands Physiographic Province. The Till Plains Section is located between Higginsport, Ohio (River Mile 425), and Louisville, Kentucky (River Mile 610). The Lexington Plain Section and the adjacent Till Plains Section incorporate approximately 25 percent of the Ohio River Valley. The Lexington Plain Section of the Interior Low Plateau Province is characterized by rolling uplands drained by deeply entrenched, mature rivers. The maturity of the rivers is exhibited by their broad bottomlands, meanders, and oxbow cut-offs. Small tributary valleys are generally narrow and v-shaped. Limestone bedrock has developed a mildly karst topography which contributes to the rolling hills appearance. The Till

Plains Section of the Central Lowlands Physiographic Province is composed of up to 25 feet of Illinoian drift near the Ohio River, has low relief, and is considered to be in a youthful geomorphic stage. Many streams have eroded valleys through the drift into bedrock; however, major tributaries predate the glaciation and are mature with deeply entrenched valleys filled with glacial outwash. No natural lakes exist in this region.

Intersecting the Ohio River Valley at Louisville (River Mile 625) is a narrow belt of conical and flat-topped knobs which rise above the Lexington Plain. These knobs are erosion remnants of the Highland Rim Section to the west. The Highland Rim Section of the Interior Low Plateau Physiographic Province begins near the Salt River Kentucky (River Mile 630), and ends near New Amsterdam, Indiana (River Mile 655). This section has the shape of a thin corridor from south-central Indiana to Kentucky, then broadens in Kentucky and circumscribes the southern portion of the Western Coal Field Region. The exact boundary between the Highland Rim and the Western Coal Field Region is not clearly defined. The Highland Rim Section is composed of two westward dipping cuestas which are separated by the Dripping Springs Escarpment (called the Chester Escarpment in Indiana). The eastern cuestas, termed the Pennyroyal Plateau, is a rolling plain with mature karst topography. Underground springs and caverns are common in this area. The western cuesta is called the Mammoth Cave Plateau and is characterized by large sinks and dismembered drainage in its valleys; the upland portions of the plateau are composed of sandstone and do not display these features. The remainder of the Ohio River Valley within the Interior Low Plateau Physiographic Province is termed the Western Coal Field Region. This region, which is located between New Amsterdam-, Indiana (River Mile 655), and New Liberty, Illinois (River Mile 928), is a low, maturely dissected plateau with silt filled valleys. In this region, the Ohio River contains many islands and sandbars. The floodplains of the river and its tributaries are very broad (up to 7.5 miles wide) with island hills common within the bottoms. The hills along the margin of the flood plain rise abruptly from the flat alluvial floor. Approximately 28 percent of the Ohio River Valley lies in the Western Coal Field Region.

The-portion of the Ohio River Valley within the Coastal Plain Physiographic Province begins approximately at New Liberty, Illinois (River Mile 928), and ends below Cairo, Illinois (River Mile 981), where the Ohio River empties into the Mississippi River. This province is subdivided into two sections, the East Gulf Coastal Plain and the Mississippi Alluvial Plain. The eastern section, the East Gulf Coastal Plain, is a belt of young to mature undulating plains of shallow marine, Reconsolidated sediments. Unstable, highly dissected loess capped bluffs, known as the "cane hills" occur on its western margin. The western section, called the Mississippi Alluvial Plain Section, begins near Mound City, Illinois (River Mile 970). It is composed exclusively of the delta of the Mississippi River and its bottomlands. Throughout both sections, the Ohio River Valley is characterized by an extensive flood plain, sandy ridges which are natural levees, numerous swamps, islands, and sandbars. Remnants of higher flood plains exist as terraces. This province contains the remaining 8 percent of the Ohio River Valley.

C.4. GEOLOGIC HISTORY

The sedimentary rocks of the Ohio River Valley were deposited in shallow Paleozoic seas upon a crystalline Precambrian basement. This basement subsided at a rate commensurate with deposition, thus forming the great Appalachian Geosyncline. Sediments thicken eastward across the study area as a result of deposition from eroding mountains formed during the late Ordovician Tectonic Orogeny east of the geosyncline during the Pennsylvanian Period, the surface of the sediments within the geosyncline was near sea level, allowing the formation of extensive ramps and peat deposits. Then, approximately 200 million years ago, during the Appalachian Revolution, this great geosyncline was uplifted which ended the Paleozoic Era. The Ohio River Valley and its related physiographic provinces have a richly developed Paleozoic section which @a worldwide standard for stratigraphers.

The succeeding Mesozoic Era was characterized mainly by erosion. Cretaceous deposits have been identified in the Coastal Plain Province along the western edge of the Western Coal Field Region in Kentucky and Illinois. Those near shore to fluvial sediments were posited in the shallow seas and estuaries of the Mississippi Embayment. Although the major tectonic events of the Ohio River Valley occurred in late Paleozoic time, the Mesozoic Era is credited as being the period of uplift which produced the most significant structural feature of the study area, the Cincinnati Arch. Also, it is believed that movement in existing major fault systems such as the Kentucky River and Rough Creek were greatly intensified during the Mesozoic Era.

By Tertiary time, highlands had been eroded to a westward sloping plain. Then differential, regional uplifts began warping the nearly horizontal strata up to 1,000 feet into the broad structural features (basins, synclines, anticlines, domes) of today. In later Tertiary time, continued uplift and erosion deeply entrenched portions of the Ohio River, its tributaries, and preexisting rivers which were truncated or, in some places completely obliterated (Teays and Marietta) by glaciation. This period of deep seated erosion was highlighted by considerable stream piracy. There is little doubt that glacial effects of the Pleistocene Epoch were ultimately responsible for creating a major portion of the Ohio River Valley. Commonly known as the Ice Age, the Pleistocene began about 1 million years ago when the Ohio River flowed from Louisville, Kentucky, to the ancient Mississippi River.

The portion from Louisville to New Martinsville, West Virginia, was drained by the now extinct Chillicothe, Teays, and Marietta Rivers. These extinct rivers converged in eastern Pike County, Ohio, and flowed north and northwest through central Ohio, Indiana, and Illinois, where they joined the ancestral Illinois River. The Monongahela and Allegheny Rivers in Pennsylvania converged and flowed north at this time, emptying into Lake Erie. Advancing massive ice sheets blocked the channels of these north flowing rivers and formed irregularly shaped lakes in the valleys. Melt water from the glaciers overfilled the valleys, which invariably eroded channels in low drainage divides. When the glaciers melted, the resulting channels through these cols or past drainage divides was lower than the original, now drift-filled valleys. The present Ohio River system of drainage was formed by connecting old channel segments with new channels which had been cut across the former divides. Ancient glacial gravels exist at over 1,000 feet elevation on some hilltops of the Ohio River Valley, indicating the enormous magnitude of glacial filling as the ice melted. By the end of the Pleistocene, the Ohio River had carved its present course. Post-glacial changes in the river and valley included terrace, levee, island, and point bar development.

C.5. STRATIGRAPHY

The Ohio River Basin is underlain by a wide variety of bedrock units ranging in age from Precambrian Era (600 million years old) in the New River Basin in North Carolina and Virginia to Cenozoic Era (recent) at the head of the Gulf Coastal Plain where the Ohio empties into the Mississippi River. These two extremes in age, however are represented by only very small areas of outcrop. The vast majority of the basin is underlain by Paleozoic rocks. Rock strata from all of the systems of the Paleozoic Era are present in the basin.

The various stratigraphic sequences are layered, interrupted, tilted, and generally controlled by the structural configuration of any area. The eastern boundary of the Ohio River watershed is formed by the Appalachian Mountains from Pennsylvania to Tennessee. This boundary is also the eastward limit of the vast deposits of thick, Paleozoic Era sedimentary rocks which form the bulk of the stratigraphic sequence for the Ohio River Basin. The tight folding and faulting associated with the bedrock units adjacent to the mountains softens into slightly undulating to nearly horizontal layers of sediments to the west. These sediments represent the erosional products of the former Appalachian Mountains. This layered structure is interrupted by two important geologic structures, the Cincinnati Arch and the Nashville Dome. These structures tend to bow-up the sedimentary sequence and have allowed erosional processes to expose older rocks which crop out in areas surrounded by younger rocks. Some rather complex geologic structures interrupt this orderly layering of the bedrock units in the extreme western portion of the Ohio River Basin. Here folding, faulting, and subsequent erosion have left sudden changes in the stratigraphic sequence. Out of this complex structural area, the Ohio flows out across the thick recent sedimentary deposits of the great Mississippi Valley.

Glacial deposits cover much of the northern portion of the Ohio River Basin, and drainage within the basin is out of this glaciated region toward the south. The streams have carried great quantities of glacial outwash materials to the south, filling the stream valleys. Streams in the unglaciated section of the basin, especially those flowing from the south, have dissected the relatively flat lying rock sequences, giving the area a mountainous type of topography. The stratigraphy of this area is easily discernible from the layers of bedrock units exposed on the valley walls.

The Pine Mountain thrust fault is a southwest-northeast trending structural feature which forms part of the control of the southern boundary of the basin and is generally considered an extension of the Appalachian Mountain system which curves around the southeastern portion of the basin.

C.5.1. Region I

That area designated as Region I (River Mile 0 to River Mile 380), is underlain primarily by a sequence of Permian, Pennsylvania, and Mississippian Period sedimentary rocks.

The stream valley is incised into middle and upper Pennsylvanian System rock from its source at Pittsburgh, Pennsylvania (River Mile 0), and for about the first 60 miles of its channel.

From approximate Mile 60 and for the next 100 miles of its course, the stream is still flowing on upper Pennsylvania System rocks, but the valley is cut through and bordered more or less continuously by Permian System rocks. From this point on to the western margin of Region 1, the stream encounters, with a few exceptions, successively older rocks. The river channel flows from rocks of the Permian System into upper, middle, and the lower Pennsylvanian System rocks and across a narrow northeast-southwest trending section of the Mississippian System rocks. The presence of a great quantity of natural resources, principally the vast coal reserves, petroleum and natural gas, and salts have led to the heavy mining and industrialization of the region which has had a profound effect on the environment.

C.5.2. Region II

That area designated as Region II is drawn to include the land mass adjacent to the Ohio River between River Mile 380 and River Mile 610. This region is stratigraphically an extension of the Paleozoic sequence encountered within Region 1.

As the river flows into Region II from the east, it flows through a channel which has been cut across narrow northeast-southwest trending outcrops of Devonian and Silurian Period sedimentary rocks. It then flows across a wide expanse of Ordovician Period rocks. To the west of these it once again crosses outcrops of the younger Devonian and Silurian rocks, but in this case it flows from older to younger rock units. This sequence can best be visualized if we imagine the river flowing across and cutting into a structural dome. This structure (the Cincinnati Arch) causes the older Ordovician System rock units to be exposed in the center of the region and to be rimmed by younger Devonian and Silurian System limestones and shales. Traversing this dome in any direction will reveal a sequence of younger to older and back to the younger rock units.

Although the rocks of Region II are quarried extensively as sources of building stone, lime, and crushed stone products, the effects of this use on the environment are very similar, especially when contrasted with the effects of the extraction and use of coal. The availability of limestone and shale has promoted the growth of a cement industry in this region. The calcareous bedrock units lead to the formation of lime rich soils that have promoted agriculture in the region. This land use, however, is limited to high yield crops because of the topography.

C.5.3. Region III

This area lies in that portion of the Ohio River Valley from River Mile 610 to River Mile 930. In this section the river forms the political-boundary between the States of Kentucky and Indiana, and a portion of the boundary between Kentucky and Illinois. Although the stream channel meanders a great deal through this region, it generally flows east to west.

The stratigraphic sequence-through this region is a continuation from Region II of-the outcropping of older units in the east to successively younger units to the west. This sequence is established by the structural attitude of the western dipping Carboniferous rock units on the west side of the Cincinnati Arch. Through this region, rocks of the Mississippian and Pennsylvanian

Periods crop out. The older Mississippian System units crop out in the eastern portion of the region to about River Mile 725 and they again crop out on the extreme western margin of Region III. The younger Pennsylvanian System units crop out in the central and western portions of the region and form a basin shaped deposit underlain and surrounded by the older Mississippian System strata. All the units in this region crop out as relatively narrow (10 to 70 miles wide) north-south trending sections. This configuration results from the truncation by erosion of the bedrock units as younger units overlap older units and dip to the west.

Mining of coal and related industries may represent the greatest environmental impact to the area and to the river. These effects were discussed in some detail in the discussion of coal mining in Region I. Agriculture is more favored in this region than in previous regions because of the lower relief, gentler slopes, and extensive bottom lands. Strip mining of coals is also more extensive in these Pennsylvanian System units than in those cropping out in Region I. Some oil and gas development has taken place within this region. The production is from older strata underlying the Pennsylvanian sequences.

C.5.4. Region IV

The area of Region IV encompasses that portion of the Ohio River Valley from River Mile 930 to its confluence with the Mississippi River at Ohio River Mile 981. Within this area, the river forms the political boundary between western Kentucky and southernmost Illinois. It is here that the stream flows southwest out of its bedrock channel on to the relatively unconsolidated sediments making up the deposits at the head of the Mississippi Embayment of the Gulf Coastal Plain. The bedrock at the base of these geologically young sediments is Paleozoic in age and has the general attitude of a monocline (all beds dipping in one direction) to the southwest. The beds dip about 30 feet per mile. It can be inferred by the extreme faulting of bedrock to the northeast that these beds are severely faulted.

Recent and Pleistocene Series surficial and alluvial deposits mantle the Tertiary in much of Region IV. The alluvial clays are sources for the clay industry in the region. Pleistocene Series loess deposits are present in much of the region and are often terraced where they are found in old or abandoned flood plains.

C.6. SOILS

The alluvial sediments on the upper Ohio River Valley consist of glaciofluvial fill or medium-coarse grained sand and gravel of Wisconsin Stage and post-glacial terrace deposits mainly of the "point-bar" type of river sediment. These glaciofluvial deposits are as much as 125 feet thick and are composed of, 45 to 83 percent locally derived pebbles of Pennsylvanian and Permian rock derivation, and foreign pebbles. Granite, quartzite, vein quartz, and chert pebbles comprise the foreign material that has been introduced into the watershed by glaciation. The sedimentary structures are predominantly the cut and fill type that is characteristic of aggrading streams. The individual beds are highly lenticular and there are abrupt changes in particle size, both horizontally and vertically. The flood plains commonly consist of thick sections of sand, silt, and clay that are commonly referred to as loams. Eolian deposits, known as loess, occur as a blanket deposit along the Ohio in the Purchase and Western Coal Field regions. Away from the river, these deposits grade into loams. East of, Mile 785 and the Green River, there is very little typical loess.

The classification of the various soil types bordering the Ohio River is by the Department of Agriculture soil taxonomy. As in other disciplines, the accuracy and-number of soil types noted are inversely proportional to the mapping scale. Furthermore, this method of soil classification more specifically addresses the requirements of agriculture than those of engineering. In the United States there are 7,000 soil series, 1,500 soil families, and 400 soil subgroups. For the purposes of this document, the great groups (collections of subgroups) are the most specific detailed classification reference.

From River Mile 0 to approximately River Mile 25, the Ohio lies within a section comprised mainly of the Ultisols. The suborder is the Udalts and the great group is the Hapludult. The predominant use of these Ultisols is general farming, woodland, and pasture. From about River Mile 25 to River Mile 330, the Ohio traverses an area where Inceptisols are predominant. The soils in this region are classed in the Onchrepts suborder and Dystrochrepts great group and occur in combination with various other suborders and great groups. These Inceptisols provide for pasture, silage corn, small grain, and hay. Between River Mile 330 and 410, the characteristic soil is the Alfisol and the Udalf suborder. The characteristic use is for row crops, small grain, and pasture. At River Mile 410, the Ohio reenters the Inceptisol, but in the Eutrochrepts great groups. From approximately River Mile 580 to Mile 600, the Alfisols of the Udalf suborder again predominate. At Mile 600, the Ohio River crosses about 10 miles of Alfisols. The Ultisols in the Udult suborder are again the characteristic soil between River Mile 640 and 710. Finally, at River Mile 710, the Ohio enters the Mollisol order. For this section of the river, the Aquolls are the most characteristic suborders with uses ranging from pasture to small grains, corn, and where drained, potatoes.

C.7. GROUND WATER

Within the Ohio River Basin ground water supplies are obtained from three general sources. Most of the ground water immediately adjacent to the Ohio River is recovered from the fluvioglacial sediments on which the Ohio flows for the greater part of its length. This primary source of water will be referred to as alluvial waters in this discussion. The second source of available ground water is found in the bedrock beneath the alluvial sediments and soils in the region. These waters are termed "bedrock waters" and they are the predominant sources of ground water where development of alluvial waters is impractical.

The bedrock strata are commonly referred to either as aquifers or confining beds. Aquifers are usually the sandstones, siltstones, and limestones that have sufficient permeability to permit the passage of water and a source of water to allow recharge. Confining beds, however, are usually shales or other rock types which do not have sufficient permeability for the transmission of water. Quite often the joints and fractures in the rock are the primary passages through which water travels. This is often the case in the limestones of the Inner Blue Grass Region as the limestone has little natural porosity, but the channelization by solution along joints and bedding planes provides passages for large amounts of ground water. The sandstones of the Pennsylvanian System are often important aquifers while the shales and limestones of the earlier Paleozoic Era are less important. Water is also obtained from the glacial deposits of the

Pleistocene. This source is present for a rather short section of the Ohio around Cincinnati and it shares many of the characteristics of the alluvial waters.

Ground water is readily available along the Ohio River. In most areas, the alluvial water is hard, but it often may be used by industry without extensive treatment. Domestic water use is often limited to that which is available from bedrock since the alluvial waters require testing to insure suitability for home use. In the alluvial areas adjacent to the Ohio, ground water is almost universally available. Due to the influence of valley slope, flood plain recharge, and river stages, the quantity available at present is proportionate to the number of wells from which the water is drawn and the rate at which the water will flow in the aquifer. Typically, after use for varying periods of time the production of individual wells declines due to incrustation. Incrustation is caused by the mineralization of carbonates and ferrous iron from the water.

The ground water adjacent to the Ohio River contains varying amounts of calcium, magnesium, potassium, iron, carbonates, bicarbonates, sulfates, chlorides, fluorides, and nitrates. Concentrations of these various anions and cations control the characteristic usually referred to as hardness. The concentration of these dissolved solids is usually expressed in parts per million (ppm). Water of hardness up to 60 ppm is considered soft; between 61 and 120 ppm, moderately hard; from 121 to 200 ppm, hard; and above 200 ppm, very hard. In addition, water containing less than 500 ppm total dissolved solids generally is suitable for most domestic and individual uses. Water containing in excess of 1,000 ppm is likely to be unsuitable for most uses. Currently, many residents use both bedrock and alluvial waters without proper testing. Bedrock waters are usually safer than alluvial water due to increased contact with filtering media.

In various parts of the Ohio River Basin, the availability of fresh ground water is limited by the presence of salt brines at relatively shallow depths. This presence is commonly indicated by increased concentration of chlorides (some agencies define salt brines as water containing dissolved solids in excess of 1,000 ppm). These brines frequently occur because of the presence of connate water or contamination as a result of improper plugging or casing of oil and gas wells. Connate brines are residual waters that were trapped during the formation of the bedrock. As the meteoric water passes through the shallow portions of the bedrock and into the deeper sections, it passes through progressively smaller openings for progressively longer periods of time. This increased time of contact alters the chemical composition of the water due to the soluble salts present in these openings. This alteration is commonly reflected by the increase in hardness and the increase in the chlorides present in the water. While the amount of connate water decreases with time, the progressive contamination by oil and gas wells continues. Moreover, once the contamination process is initiated, it is further aggravated by the continual drilling for the development of fresh water supplies. Salt brines are available at depths of less than 150 feet below the ground surface along many parts of the Ohio. As the Ohio River approaches the Mississippi River, the fresh-saline interface progresses downward and at the mouth of the Ohio, the interface drops very sharply to elevations below sea level.

In the alluvial areas adjacent to the Ohio, valley slope and floodplain recharge areas and river stages influence piezometer levels. The West Virginia Geological Survey conducted a 22-day test in which a well was pumped at average daily rates in excess of 400 gallons per minute. Measurements were taken in adjacent wells to determine the limits of the cone of depression that was established. The results revealed that the river stage during this period affected site specific ground water levels. At other sites, industrial well field development, seasonal effects

and flood stage conditions were evaluated and positive gradients toward the river persistently defined. Piezometer installations have been installed and ranges are being evaluated. The elevation of the river appears to establish the local base level that is sought by the inflowing ground water from the adjacent areas.

C.8. STRUCTURAL GEOLOGY

The main geologic structures along the Ohio-West Virginia border trend roughly parallel to the Allegheny Mountains in a general southwest-northeast direction. From Pennsylvania to Kentucky, the Ohio River Valley also follows this general direction and lies west of the nearly parallel axis of the Appalachian Basin (also commonly known as the Pittsburgh-Huntington syncline). Within this basin, rock exposures along the Ohio River dip very gently to the southeast at approximately 30 feet per mile. The Appalachian Basin is interrupted by the Burning Springs Anticline (called the Cambridge Anticline in Ohio) which intersects the Ohio River just east of Marietta, Ohio (at River Mile 160). In Ohio, the Parkersburg-Lorain Syncline parallels the Cambridge Anticline to the west and begins at Parkersburg, West Virginia (River Mile 690). These complementary structures trend approximately north-south. These anticlines and synclines and other minor folds of only local significance within the Appalachian Basin have been highly productive in oil and gas along the Ohio River Valley.

Westward into Kentucky, the dominating structure along the Ohio River Valley becomes the Cincinnati Arch. This north-south trending anticline splits into the Findlay Arch and the Kankakee Arch just south of Cincinnati and their axes intersect the Ohio River on each side of the city (River Mile 485 and River Mile 450). The geologic configuration of the Cincinnati Arch has had considerable impact in determining the distribution of oil and gas production in Ohio and Kentucky.

The counterpart of the Appalachian Basin is the Illinois Basin which is encountered just west of Louisville, Kentucky (River Mile 610). This broad intercratonic depression trends approximately northwest-southeast and extends west to about Paducah, Kentucky (River Mile 930). Coal production is the most important economically related impact on the Illinois Basin. The Ohio River within the Illinois Basin is almost evenly bisected by the Rough Creek Lineament. This three-component major fault system extends from south-central Illinois to west-central Kentucky. One of its components, the Shawneetown Fault, crosses under the Ohio River near Shawneetown, Illinois (River Mile 855). Even though it is upthrown on the south by as much as 3,500 feet, differential uplift and erosion have resulted in a topographic change of only several hundred feet between the banks. Numerous local swamps along the Ohio and mouth of the Wabash Rivers are also attributed to this fault. Recent petroleum explorations into the Precambrian basement have revealed a semicontinuous east-west scarp below the Rough Creek Lineament and several other fault zones across central Kentucky. This basement scarp has an apparent vertical displacement of about 5,000 feet and is responsible for a disturbed belt of Paleozoic rocks which extends from southern Illinois for some 400 miles into southern West Virginia. Downstream of the Shawneetown-Rough Creek Fault, the remainder of the Illinois Basin consists of the Illinois-Kentucky fluorspar district. This portion of the basin is crossed by a network of faults trending northeast to the Shawneetown Fault with displacements up to 2,000

feet. Many of these faults are followed by veins of fluorspar and other minerals-and have significant economical impact on this area.

The Mississippi Embayment, encountered at New Liberty, Illinois (River Mile 981), is the structural feature containing the remainder of the Ohio River. It was formed by the tectonic process of subsidence with the accumulation-of the deposits now found there. Its main structural feature is its low topographic relief and gentle seaward dip with its strata increasing in thickness.

C.9. SEISMOLOGY

Consolidated sediments of the Appalachian Geosyncline were uplifted and folded into the existing structures as the earth's crust relieved its internal stress. Where these stresses were great, the strata often ruptured and faulted in addition to being folded. Movements in major faults occur repeatedly throughout time in specific regions or zones and because they occur without warning, the impact of faults on an area is based wholly on its seismic history.

Based on the known distribution of damaging earthquakes and the Modified Mercalli intensities associated with these earthquakes, the Ohio River Valley has been divided into three seismic risk categories. Seismic Risk Zone I includes the region between Pittsburgh, Pennsylvania (River Mile 0), and Cincinnati, Ohio (River Mile 470). Very few earthquakes are expected in this region and most of those that occur would probably be unnoticed by the casual observer. In this area, slight damage would be limited to buildings of average construction. The region between Cincinnati, Ohio (River Mile 470), and Evansville, Indiana (River Mile 785), is classified as Seismic Risk Zone 2. Moderate to considerable damage in well-built structures with wall and chimney collapse can be expected in this region. Seismic Risk Zone 3 includes the region from Evansville (River Mile 785) to Cairo, Illinois (River Mile 981), and is considered to be area where major destructive earthquakes may occur. Considerable damage can be expected in this region with buildings shifting off their foundations and the ground developing strong cracks and openings.

C.10. ECONOMIC GEOLOGY

The industrial development of the Ohio River Valley is due in large part to the accessibility of economically important rocks and minerals. Of central importance are the deposits of coal, oil, gas, salt, clay, sandy gravel, limestone, and sandstone. Other economically important products include zinc and fluorspar. The economic deposits of rocks and minerals are described state by state in the following paragraphs since most information is available in that format in the geological literature.

C.10.1. Pennsylvania

The major mineral produced is coal. Pennsylvania ranks third in its production in the nation after Kentucky and West Virginia. The coal occurs as anthracite in the eastern part of the state and as bituminous elsewhere. Salt beds and oil and gas are found in the west.

C.10.2. West Virginia

The major economic mineral in West Virginia is bituminous coal, of which 95 million short tons (2,000 lb.) were produced by more than 1,340 mines in 1978. In the state, 117 different coal seams have been named. According to the 1974 Bureau of Mines Mineral Yearbook, West Virginia ranks second in coal production, after Kentucky. Natural gas, oil, and salt brine dominate the western two-thirds of the state. About 350,000 short tons of clay are quarried annually from seven scattered counties. The northern panhandle and the region near the base of the panhandle are underlain by rock-salt beds averaging 100 feet in thickness at a depth of about 6,000 feet.

C.10.3. Ohio

Coal production accounts for the highest economic return, followed by building stone, lime, Portland Cement, and sand and gravel. Ohio ranks fifth in the nation in coal production, is first in sandstone production, providing about two-thirds of the nation's building sandstone, and is third in sand and gravel production. The abundance and quality of clays have made Ohio a leader in the manufacture of ceramic products. Almost one-half of the salt production comes from natural brine with the other half obtained from rock-salt mines. Ohio has produced oil and natural gas since 1860, resulting in the depletion of these resources and a decline in production. In the early 1960's, however, new oil and gas fields were discovered and the industry has experienced a revival.

C.10.4. Kentucky

Kentucky is first among the states in coal production. Other economic deposits include building stone, fluorspar, oil, and natural gas.

C.10.5. Indiana

Indiana's quarries, primarily in the Bedford- Bloomington region, produce more building stone than any other state. Ranking seventh nationally in coal production, bituminous mining operations exist in the southwestern part of the state. Small amounts of gas and oil are produced.

C.10.6. Illinois

Illinois ranks fourth nationally in coal production and eighth in petroleum. The fluorspar district in the southern tip of Illinois provides the largest output of fluorspar in the world. Illinois is also a leader in the mining of lead, zinc, limestone, and silica sand used in the glass industry.

C.11. CLIMATE

The climate of the Ohio River Basin is continental in nature with marked contrasts in temperature and moisture. The average annual temperature is about 54°F. Summers are warm and humid with temperature exceeding 100 for short periods except in higher elevations. Average July temperatures range from 80 F in the southwestern part of the Basin to 70°F in the extreme northeast. Extreme summer temperatures have reached 110°F in some locations. Winters are relatively cold, with the lowest recorded reading in the Basin approaching -30°F. Average January temperatures range from 40°F in the south to 26°F in the northern portion of the Basin. Temperatures for selected Ohio River Basin stations are given in Exhibit 82 in the Technical Appendix.

The average frost-free period in the Ohio River Basin varies from April 10 to October 20 in the southernmost portion of the Cumberland Basin to the period May 30 to September 30 in the Allegheny Basin. The average growing season then varies from 200 days in the south to 120 days in the north; although recorded extremes have varied from 247 days to 73 days.

Prevailing winds, with velocities averaging 6 to 12 miles per hour, are generally from a southerly or southwesterly direction on the plateaus, but originate in a more westerly direction in the mountains. Winds with velocities of 50 miles per hour have occurred in every month and from every direction but east. Maximum winds have exceeded 80 mile per hour. For example, an average of nine tornadoes a year strike Indiana, occurring on 5 days per year. However, recent improvements in reporting data indicate these averages are probably much too low. High winds may also be associated with thunderstorms or intense large area storms, tropical storms, and hurricanes. However, damage from hurricanes is uncommon.

The most common storm activity in the basin is produced by the passage of warm, moist air from the south or southwest coming into contact with cooler, often drier, air from the north or northwest. One type of storm is characterized by long duration, relatively low intensity, and wide extent during which an enormous amount of rain falls. The weather systems which result in these widespread flood-producing storms originate by the opposing action of two large stationary anticyclones ("highs"). One is located off the Atlantic Coast; the other is entrenched over the upper portions of the Mississippi and Missouri Basins, or occasionally, north of the Canadian border. These produce a more or less stationary front which lies northeast to southwest across the basin. Along this front, a succession of "moist waves" may move northeastward, resulting in bursts of heavy warm rains for prolonged periods. The condition continues to exist until there is a displacement of one or both of the anticyclones. Meteorological conditions such as these are

confined to winter or early spring. The floods which occurred in January 1913, January 1937, and March 1964 were produced by this type of storm.

Another condition causes moderate to fairly heavy, and sometimes intense, precipitation for a period generally not exceeding 5 days, over smaller areas. This condition involves one or more closely related cyclones ("lows") and occurs most frequently from December to April when soils are generally saturated. The floods which occurred in, February 1884, March 1913, and March 1936 are examples of this type of storm. These storms may occur during the summer, but less-saturated soils reduce the runoff. These summer storms of the conventional type are often characterized by cumulonimbus thunderheads, lightening, and intense rainfall (occasionally including hail) in localized areas.

Increasing altitude cools warm, moist air producing rainfall, cloudiness, and fog. As a result of this orographic effect, many of the ridges and mountainous areas have slightly different climate-s than the lower valleys. Finally, man's activities may have a small effect on climate where urban-industrial areas are concentrated. That such clusters can modify wind movement and temperature balance so as to induce more severe weather has been documented in the St. Louis metropolitan region.

C.11.1. Precipitation

Precipitation in the Ohio River Basin varies considerably from location to location and year to year. Recorded annual precipitation extremes have ranged from 20 inches in 1930 at Parkersburg, West Virginia, to 72 inches in 1927 at Paducah, Kentucky, and with heavier precipitation reported in the Tennessee River Basin.

The greatest amounts of precipitation usually occur in June or July and the minimum in October with minor variations due to elevation and location. Precipitation data for selected stations in the Ohio River Basin are given in Exhibit 82. Snowfalls in the Basin may be heavy but are usually followed by gradual thawing periods. Large scale basin-wide melting in the spring is rare.

C.11.2. Ice on Streams

Ice occurs on all streams in the basin, varying in thickness and duration, depending on location, exposure, streamflow, and length of cold spell. Ice more than 18 inches thick has formed on tributaries. Ice on the Ohio main stem occurs more frequently in the upper reaches; although the river froze over for nearly its full length in the winter of 1976-1977 and again in the winter of 1977-78; this is a rare occurrence. In some years, ice has interfered with navigation.

Prior to the construction of the modernized dam system authorized in 1954, river freezing occurred more often. The new, deeper pools have reduced river freezing, chiefly because they act as heat sinks and it takes longer for them to freeze.

C.11.3. Drought Periods

Precipitation is generally sufficient for agriculture, but occasional soil moisture deficiencies result in low streamflow and cause vegetation to wilt. Droughts are usually local in nature and crops are seldom ruined, but economic loss may occur due to yield reductions. The need for supplemental irrigation water occurs mainly from July 1 to August 15 and is of relatively low demand. Major droughts in the Ohio Basin occurred in 1894, 1895, 1901, 1914, 1930, 1934, 1936, 1941, 1953, and the recent drought which started in 1962 and continued through 1965. The most severe Basin-wide drought of the 20th century occurred in 1930. Based on available data, the most severe drought in the 19th century was in 1895.

C.11.4. Runoff

The average annual runoff for the Ohio River Basin is 17.3 inches. Although the average monthly precipitation is fairly well distributed, on an annual cycle, the runoff is greatest during the winter and early spring and lowest in the late summer and fall.

C.11.5. Infiltration

The winter infiltration indices in the area vary from 0.004 to 0.4 inches per hour. Infiltration losses during the dry summer and early fall are much higher. Almost complete retention of rainfall occurs with light summer precipitation. Losses during intense summer storms which occur after periods of dry weather have been as high as 0.2 to 0.3 inches per hour. Studies of hydrologic records indicate that infiltration losses of 0.02 to 0.05 inches per hour is a representative minimum value to be used for flood control reports for the Ohio Basin summer storms.

C.11.6. Floods

The Basin lies directly in the path usually followed by cyclonic disturbances as they move from west to east in the winter and early spring. For this reason, it frequently has more than normal rainfall from January to March, when infiltration, transpiration, and evaporation are at a minimum, and rainfall-runoff relationships attain their maximum. This is a major factor accounting for the large flood flows then likely to occur. Another contributing factor is the rapid runoff caused by the precipitous slopes of the mountainous regions bordering the Basin to the east and southeast.

Frequency of flooding data for the Ohio River has been compiled by the Ohio River Division Office. Natural maximum annual curves were developed in accordance with procedures set forth by Leo R. Beard in 1962. For the natural flood frequency computations, all observed

flows were restored to natural conditions. The computed statistics for the entire period of record were then adjusted by reconciling adjacent points and comparison on drainage area proportions to produce consistent statistics throughout the length of the main stem. Stage frequency curves were developed by converting flows to stage through the use of crest stage-maximum discharge relationships plotted from historical data, and extended rating curves prepared in connection with the Ohio River Standard Project Flood Study.

To determine modified flows, 12 historical and 3 hypothetical floods considered to be representative of the Basin were modified by the operation of the Corps of Engineers projects completed, under construction, or in the advanced planning stage as of Fiscal Year 1976. The modified flows were plotted against the natural flows to define curves indicating the average reservoir system response to flows of various magnitudes.

Major floods of modern record affecting the main stem Ohio occurred in March 1913, March 1936, January 1937, March 1945, and March 1964. Brief descriptions follow:

(1) The March 1913 inundation originated in the northern part of the Ohio Basin, particularly in the watersheds of the Beaver, Muskingum, Scioto, Great Miami, and Wabash Rivers, where all previous high-water records were exceeded. The southern tributaries contributed no more than moderate flow. Through 1976, the 1913 flood has not been exceeded on the main stem in the reach from New Martinsville, West Virginia, to upstream from the mouth of the Kanawha River at Point Pleasant. The peak discharge of Pomeroy, Ohio, was 633,000 cfs in March 1913.

(2) The March 1936 flood was caused by storms centered largely over the Monongahela and Allegheny River Basins, with particularly heavy rainfall in the mountainous eastern portions of these basins. Snow melt added to the runoff, and in some areas was greater than the rain. The heavy rains were so timed that flood crests on the Monongahela and Allegheny Rivers arrived almost simultaneously at Pittsburgh, resulting in a record high. Record stages also occurred on the main stem 23 miles up the Monongahela River to Elizabeth, 45 miles up the Allegheny to Kittanning, and 114 miles down the Ohio.

(3) The flood of January-February 1937 was the most disastrous ever in the Ohio Basin. Excessive and almost continuous rainfall from January 6 to 25 caused maximum record stages in a 705-mile reach of the Ohio River from below the mouth of the Kanawha River at Point Pleasant, West Virginia, to the mouth of the Ohio River at Cairo, Illinois. This flood interrupted-virtually all communication and transportation between the north and south banks for periods of a week to a month. Every highway bridge approach between Marietta, Ohio, and the mouth of the Ohio River, a distance of 800 miles, was flooded and closed to traffic with the exception of the suspension bridge at Cincinnati, where approaches were raised by an earth and sandbag ramp. Except for the lower reaches of the Cumberland, Green, and Kentucky Rivers, this was not the most severe flood on the Ohio River tributaries. It did, however, produce record stages on the Cumberland River for 160 miles upstream, above the present location of Cheatham Dam.

(4) The 22 reservoirs in operation on the upper portion of the Basin at the time of the March 1945 flood were effective in reducing flood stages downstream to below Louisville. Below there the reservoirs had little effect on the crest stage.

(5) The March 1964 flood was the fourth highest flood of the century at Cincinnati (stage 66.2 feet) and the maximum of record in the Licking and Little Miami Basins. The heavier rains were concentrated in the area along the main stem of the Ohio River with rainfall exceeding 16 inches at Paducah, and 13 inches at Louisville. Many of the large floods on the main stem of the Ohio River had discharges above flood stage continuing for many days. The one in March 1964 exceeded flood stage at Cincinnati for 11 days. By comparison, at Cincinnati, the 1937 inundation exceeded flood stage for 19 days and the one in 1936 for 21 days.

The magnitude of the area affected by flooding can be seen from the approximately 5 million acres of flood plain located along the Ohio River and the lower reaches of its tributaries. Land use within the floodplain has been estimated to be approximately 48 percent for cropland and pasture, 39 percent in woodland cover and forest preserves and 13 percent occupied by urban development and improvements of public, commercial, and industrial enterprises, etc. Considerable work has been done to mitigate the costly and disastrous consequences of floods. Projects along the Ohio River and its tributaries include flood control reservoirs, levees and floodwalls, stream channel improvements, and other watershed management practices. The Corps of Engineers, as well as other Federal, state, and local agencies are involved in this continuing effort.

The present system of the flood control and multipurpose lakes constructed by the Corps of Engineers controls 51,165 square miles or about 31.4 percent of the Ohio River drainage. Kentucky Dam on the Tennessee River, a project constructed by the TVA, provides additional flood control on the lower Ohio River. Also structures with flood control capacity have been provided by the Soil Conservation Service (SCS), conservancy districts, several states, and others. This system of reservoirs has significantly altered flow characteristics of the Ohio River, reducing flood crests, lengthening the duration of bankfull stages, and reducing the severity of low flows during drought periods.

C.12. SEDIMENTATION

Suspended sediment records, published by the U.S. Geological Survey, are available for stations located on various streams in the three predominant physiographic provinces of the Ohio River Basin. Sedimentation yields in the three physiographic provinces vary widely. High yield areas are prevalent in West Virginia, Pennsylvania, southeast Ohio, Kentucky, and southwest Illinois where extensive land disturbance associated with mining and timbering operations combine with steep land slopes and fast flowing streams to create deposition within receiving streams. Measured annual sediment yields on some streams in this region have exceeded 6,000 tons per square mile of drainage area.

Low sediment yields are found in the Central Lowland province. Although this area is cultivated extensively, erosion is relatively less severe because of flat and gently sloping land.

Undisturbed forest land with adequate ground cover will generally produce about 20 tons of sediment per year per square mile. Other sources of sediment in the Ohio River Basin are eroding farmland, roadsides, slopes, and streambanks. Exposed areas in watersheds undergoing

urban development constitute another significant source of sediment. During construction, it is not uncommon to have annual sediment yields 50 to 100 times the yield from other nearby vegetated areas.

Problems that can result from sedimentation are:

- a. Sediment deposits in navigation channels and harbors, which require periodic dredging.
- b. Increased frequency of flooding as a result of deposition in channels may cause problems in tributaries but not on the Ohio River itself.
- c. Destructive sediment deposition on agricultural land.
- d. Damage during floods to structures and contents, and to mechanical equipment through silt diffusion.
- e. Changes in aquatic ecology.

C.13. STREAM MORPHOLOGY

Stream morphology, which deals with the structure of the channel and meander belt, is not a static phenomenon. The topic interlaces the subjects of meteorology, geology, hydrology, hydraulics, soils, sediment transport, and others.

Streams that are relatively stable exhibit dynamic near equilibrium among all the force's occurring during the movement of water through the system. Although a system may be relatively stable during, frequently encountered flows, it may dynamically change during wet weather periods, storms, and flood events. If a morphological parameter changes, adjustment will occur with the trend again toward dynamic near equilibrium. The period of time required to reach a balance may be very short, a few years, or it may be quite prolonged.

The present Ohio River is relatively stable and has inherited the major drainage patterns and channel locations from its Pleistocene' predecessors. As compared to those predecessors, the recent reduced discharges, somewhat flat gradient, controls, and relatively resistant bank materials result in significant changes only during floods. Significant bank and slope failures and erosion, transport, and sediment deposition have occurred during major floods. At any one site, the relative bank locations will vary while width and depth ratios and geometries remain relatively constant. As with all rivers, the Ohio, as defined by historical and present conditions, is dynamic and indicates the complex influences of topography, geometry, hydrology, hydraulics, materials, controls, and land use.

C.14. GEOMORPHIC CONSIDERATIONS

The geomorphology of the Ohio River and its valley, from historic and prehistoric records, indicates that bank erosion and slope failures, sediment transport and depositions are common naturally occurring events. The forces exerted by flood flows and wetting of banks

during major floods and during long periods of local precipitation have been and are the primary triggering mechanisms.

The Ohio River below Pittsburgh flows through a relatively flat-lying sequence of sedimentary rocks. Locally the dimensions of the valley are controlled by the erodibility of these materials. The valley from Ashland, Kentucky, downstream to within a few miles of Louisville is relatively narrow. This section of the valley is influenced by the relatively resistant shaly limestone that forms the valley walls. From above Louisville to West Point, the valley widens where erodable soft shales form the valley walls. Below West Point, the river again enters an area of resistant limestone, and it remains narrow for about 90 river miles until near Hawesville where the valley again enters soft shale and thin sandstone. The valley narrows again near Shawneetown, as it is affected by resistant sandstones, but it broadens again near the mouth of the Cumberland River, where it enters the unconsolidated sediments of the Mississippi Valley.

It is apparent that the dimensions of the Ohio River Valley are influenced by the erodibility of the rocks forming the valley. In addition, the character of the valley strongly influences the behavior of the Ohio River in two ways.

First, the bedrock walls of the valley confine the modern river and prevent it from assuming the pattern of an alluvial river. For example, compare the river in the Meldahl Pool and in the upper part of the Cannelton Pool with that in the lower Cannelton Pool below Leavenworth. In the Meldahl Pool, the river is in a relatively straight valley and the river shifts from one side to the other side of the valley. If the river were not confined, it might develop a meander pattern with a meander wavelength of about 6 miles. In the upper Cannelton Pool above West Point, the river is in a wide section of valley, where it presumably can assume the form dictated by discharge and sediment load; nevertheless, except for one large bend, the river is relatively straight. However, below West Point, the valley is sinuous and the river is forced by bedrock controls to assume this pattern. If the bedrock controls were removed, the river would probably tend to straighten in this reach by cutting off the meanders.

Second, the location of bedrock controls and the pattern of the bedrock valley obviously influence the present Ohio River. The river is flowing on and in alluvium that was deposited when glaciers occupied part of the Ohio River Basin. This material is different from sediments presently being transported by the river. For example, over a short distance, the nature of the sediment changes and so does the failure and credibility of the banks. Therefore, if the river shifts its position slightly, the stability of the riverbanks can be significantly affected.

C.15. HYDROLOGIC CONSIDERATIONS

Almost all significant bank erosion occurs during periods of high discharge. For significant bank erosion to occur, the river must be able to transport large quantities of sediment. This condition, exists only during periods of high flow. In fact, rivers have a capacity to erode their banks and transport sediment during flood stages that is 100 times or more greater than that capacity which exists during periods of intermediate to low flow. In some

instances, when considering the instability of alluvial rivers, approximately 90 percent of all river changes occur during approximately 5-10 percent of the time when significant flows occur.

C.16. HYDRAULICS AND CHANNEL GEOMETRY

The Ohio River is a relatively stable river when compared with other systems of similar size and type. This can be verified by considering the hydraulic relations for a variety of rivers and comparing conditions that occur on the average for other alluvial river systems. The Ohio River is narrower than alluvial channels commonly studied. Similarly, the depth is larger and width-depth ratio is smaller. The fact that these three parameters orient themselves this way in relationship to the trends established by studying other alluvial rivers verifies that the Ohio River is in fact very stable.

C.17. FACTORS AFFECTING BANK EROSION AND CHANNEL STABILITY

One of the variables most closely related to channel stability or channel instability is the velocity of the water. Modernization of the locks and dams has significantly reduced the velocities the channel banks are subject to during periods of low and intermediate flow. Also, during periods of flood stage, the locks and dams, whether small or large, have little or no effect on the velocities of the water flowing in the Ohio River at this location.

The construction of the locks and dams has resulted in smaller, less erosive velocities in the channels during periods of low and intermediate flow. The velocities at flood stage have not been reduced by the construction and operation of the high locks and dam, and hence, the velocity at flood stage for both the natural and developed river is subject to little or no change. With respect to velocities of the flow, it is concluded that the construction and operation of the current lock and dam system does reduce the attack on the banks by the flowing water by virtue of the fact that during periods of low to intermediate flow, the velocities are of a smaller magnitude than they would be in the natural, undeveloped system.

The above conclusion can be further verified by considering the capacity of the river to erode and transport sediment. Let Q_s represent sediment discharge in the river channel. An analysis of sediment transport relationships shows that the sediment transport Q_s is proportional to the average velocity V to the fourth power, V^4 . At low flow the velocity may be on the order of 1.5 fps or less. At flood stage, the average velocity in the channel will be on the order of 5 feet per second or more. If one, then, takes the ratio Q_s during periods of flood to Q_s during periods of low flow, we see that this ratio is equal to 5 divided by 1.5 - 123.5. Hence, the ability of the river to erode banks is much greater during periods of high flow than during periods of low to intermediate flow.

A limited amount of bank erosion occurs during periods of low flow for a variety of reasons, but it is quite minor in comparison with the bank erosion that occurs during periods of high flow. The following paragraphs discuss those conditions under which low flows can cause bank erosion.

In the raising of lock and dam pools, the water surface is at a higher elevation a greater percent of the time than before for elevations below control stage. Control stage is defined as the elevation where the gates of the locks and dams are not needed to maintain navigation pools because of increased flow in the river. The duration tends to concentrate about a prevailing elevation and in the case of the lock and dam, it is the normal pool. For the run of river conditions, it becomes a flow control elevation, or a low water elevation. Duration curves merge at a higher elevation and result in the same relation as would occur in the run of river conditions. Another important facet is that at higher elevations (i.e., flood elevations) the gates are raised clear of the water and the piers between gates are the only obstructions. The river then flows essentially under conditions prevailing before construction of the navigation dams. Consequently, at higher elevations, the duration curves with locks and dams affecting the elevation begin to approach natural conditions, which means at higher elevations the duration curves are not affected by the lock and dam operation.

Surface waves are common on rivers and, in particular, they are common on navigable rivers. Waves can be formed by the interaction between the wind and water, by barges, recreational craft, etc.; in fact, one can observe complex waves that are the product of both wind and vessels. In the case of the Ohio, both wind waves and waves generated by watercraft are of concern. For wind waves, fetch distances have not been significantly increased by raising the pool levels. Also, maximum winds normally occur during periods of high flow in portions of the Ohio River.

The wind and vessel generated waves cause some surface erosion by runup, local saturation, and sediment transport. After construction of the high lift dams, when the pool stage is held constant over relatively long periods of time, the duration of wave action at a particular level is increased and these waves attack the bank at essentially a fixed level. However, these wave forces are negligible at normal pool when compared to the erosive action that banks are subjected to during periods of flooding.

C.18. FLOW ALIGNMENT AND FLOW DISTRIBUTION

Several important features are identified in the profile of a meandering river; the low flow thalweg, the flood stage thalweg, the point bar deposits, and the radius of curvature to the thalwegs. The low flow thalweg runs close to the outside of the bend. Even during the low flow season this can cause some erosion where the strongest low flow current is adjacent to, and sometimes impinges on, the bank. As the outside of the bend is eroded, there is deposition on the inside of the bend. This deposition on the inside of the bend of a meandering river is referred to as a point bar. With time, the older part of the point bar is covered with vegetation, grows in amplitude from sediment deposition and becomes part of the flood plain. With flood flows, the

thalweg straightens and pulls away from the outside of the bend because of high velocities and tractive force. At the time the thalweg shifts away from the outside of the bend, the radius of curvature increases and the new alignment of the flow may cause significant erosion of the point bars. In many instances, chute channels are developed across the point bar during periods of flooding. Hence the outsides of the meanders are subjected to some erosion but they continue to grow intermittently with time.

Some scour occurs in meandering systems and particularly on the outside of bends during periods of low flow. During periods of flooding, the position of the current and its magnitude is such that significant erosion can occur on the outside of bends, on the inside of the bends, and in many instances, in the crossings connecting the bends.

In a meandering river with a relatively straight reach between the two bends one must bear in mind that the thalweg changes its position with time and with discharge. The point bars form on the insides of the bends. However, when there is a relatively long, straight reach between two bends, the thalweg meanders in this straight reach around sedimentary deposits referred to as alternate bars. These alternate bars are unstable, both with respect to time and space. They are a function of the flow and of the sediments transported by the river. Bank scour occurs when the thalweg is deflected around an alternate bar toward the bank and the deposition occurs on the opposite side of the river forming an alternate bar. The flow meanders around them. The number of these alternate bars in a straight reach depends upon the length of the straight reach, the magnitude of the flow, the duration of the flow, the characteristics of the bed and bank material and other variables. Areas of bedrock control can shift the location of erosion attack.

It is important to stress that alternate bars always form in straight reaches of alluvial channels. The position of those bars changes with discharge and duration of flow. Hence, locations of local scour and deposition vary with time. Over relatively long time periods, both banks will be subjected to scour and deposition. Hence, at one point in time, deposition may be occurring along the bank line. Simultaneously, scour occurs on the opposite bank and subsequently, both banks of the straight reach are subjected to some degree of erosion.

C.19. GEOMORPHIC

The geomorphic history of the Ohio River is complicated and the character of the modern river is influenced by this history. The morphology of the Ohio Valley and the nature of the sediments on which the river flows are the result of disarrangement of the preglacial drainage pattern, valley cuttings, and valley filling with outwash from the continental ice sheets. Limited information indicates that the channel has been active during the past 14,000 years, but during the past 2 centuries, the position of the river in this valley has remained relatively fixed.

The present distribution of stable, eroding, and stabilizing banks clearly indicates that a given length of bank, if not protected by bedrock, will undergo erosion, and then colonization by vegetation to a condition of renewed stability. This appears to be the sequence of events exposed for all alluvial banks in the Ohio Valley. Bank erosion occurring after the raising of the lock and dam pools can be attributed to this sequence, and it is coincidental. Abundant evidence of

prepool bank erosion exists and erosion in the upper part of the new pools, where no rise of water level occurred, is similar in magnitude and distribution to that occurring where the water level was raised (After Schumm, 1977). The operation of the locks and dams are not significantly affecting the geomorphology of the river.

C.20. WATER QUALITY

C.20.1. Existing Water Quality Conditions in the Ohio River

The navigation system affects, directly and indirectly, the water quality of the Ohio River. The system encourages use by industry and commerce. In turn, these activities stimulate higher population densities, Intensive land use, pollution, and consumption of water. Any discharge to the river requires an EPA National Pollution Discharge Elimination System (NPDES) permit. Water quality is monitored by the Ohio River Valley Water Sanitation Commission (ORSANCO) and spills are under the jurisdiction of the U.S. Coast Guard.

The system modifies the flow of the river with subsequent impacts on water quality. Longer retention times (at below normal flows) occur and turbulent reaeration is reduced within the navigation pools. The basin-wide system of storage reservoirs is instrumental in modifying flow regimes and water management. These reservoirs, located on tributary streams, reduce flood peaks and conserve excess water for release during low flow periods. Such releases improve water quality conditions in the lower tributaries and along the Ohio River mainstem. During extreme low flow periods, as much as half the flow in the Ohio River is provided by reservoir storage.

With the establishment of the navigation system, the hydrodynamics of the river resemble uncontrolled rivers during high to moderate flows. During extremely low flows, it resembles a chain of lakes. The longer retention time (at normal and low flows) for a given volume of water allows for certain physical, chemical, and biological reactions to occur within that volume. Formation of the pool reduces turbulent re-aeration. These processes are treated in a subsequent section.

The water quality of the Ohio River varies with season and flow along its 98C-mile long course. Numerous local anomalies can occur, but in general, as the river flows downstream it becomes somewhat warmer and higher in dissolved matter, alkalinity, and planktonic algae density and diversity. The system is highly dynamic and many of these relationships are very complex. Locally, any effluent may affect the quality of the water.

Ohio River water may be classified as moderately hard to hard depending on the season of the year, with concentration showing an inverse relationship to flow. During high flow in winter and early spring, hardness values range from around 80 to over 200 mg/l (as CaCO₃). The higher values occur in the downstream reaches. ("Upper", "Middle", and "Lower" reaches of the river correspond to the respective thirds of the Ohio, with Pittsburgh considered the head of the upper reach.) At lower flows during late summer, maximum hardness may range from 200 to over 300 mg/l, with the higher values occurring in the middle and upper stream reaches.

The pH of the Ohio River is generally within the ORSANCO limits except for occasional low values in the upper reaches due to acid drainage and high values in the lower reaches due

to algal activity. Of the major anions, sulfates generally exceed chlorides, with maximum values reaching 250-300 mg/l and 100-150 mg/l, respectively. Highest sulfate values are generally associated with mine drainage and the upper basin. The major cations of calcium (Ca), magnesium, (Mg), sodium (Na), and potassium (K) generally occur in the following order: $Ca > Na > Mg > K$, with sodium and magnesium concentrations approaching one another more closely downstream. With occasional local exceptions of iron and manganese, heavy metals are found generally in low concentrations. Periodic spills of toxic and polluting materials may temporarily affect water quality. Assimilative capacities of the river have been the subject of many studies, much computer modeling, and general concern in the recent past. Dissolved oxygen (D.O.) predictions form the basis for calculating these capacities in the river and the overall "quality" of the ecosystem. In general, there is a pattern of D.O. depression downstream from major population centers, with gradual downstream recovery. Although this pattern remains, the degree of D.O. depletion has changed radically in the last 25 years as the discharge of raw sewage has been virtually eliminated. Major sewage treatment plants either now or soon shall provide secondary treatment and such operations are reflected in the D.O. values. Further upgrading of treatment is predicted for most systems in the basin.

Currently over 300 sewer communities, with a total population of more than 3.6 million people, discharge treated waste into the Ohio River. Of these, about 45 percent have at least secondary or better treatment, while 55 percent have primary or intermediate treatment.

With regard to the major municipal point source discharges of oxygen-demanding loads to the river, secondary treatment facilities have been completed for most as of the end of 1976, the latest year for which full data are available. The completed facilities serve 158 communities with a sewer population exceeding 2 million. Secondary facilities for the remaining communities are scheduled for completion.

High bacterial concentrations are associated with major population centers. Improvements in sewage treatment have resulted in significant reductions in coliform bacterial concentrations in the river over the last quarter century.

C.21. TERRESTRIAL BIOTA VEGETATION

The Ohio River crosses three Regions and seven Sections of the Deciduous Forest Formation of eastern North America, which encompasses the entire Ohio River Basin. These are the Cumberland and Allegheny Plateaus Section of the Mixed Mesophytic Forest Region (upper Ohio River main stem region from Pittsburgh, Pennsylvania, to Portsmouth, Ohio); the Area of Illinoian Glaciation and Bluegrass, Hill, Mississippian Plateau and Mississippi Embayment Sections of the Western Mesophytic Forest Region (lower Ohio River main stem region from Portsmouth, Ohio, to Paducah, Kentucky), and Mississippi Alluvial Plain Section of the Southeastern Evergreen Forest Region (lowermost Ohio River main stem region from Paducah, Kentucky, to Cairo, Illinois).

The mixed mesophytic and western mesophytic forests of Braun have been classified broadly as a "Tulip-Oak Region". The greater part of the tulip-oak forest "lies between 500 and 1,000 feet in altitude, but in places ranges above 3,000 feet. The dense, mixed mesophytic forest contains a fair abundance of two indicator species, white basswood, and yellow buckeye, in a total group of 15 to 20 dominant species."

The Western Mesophytic Forest Region, an irregular band 100-200 miles in width west of the Cumberland and Allegheny Plateaus, is marked by a transition from extensive mixed mesophytic communities in the east to extensive oak and oak-hickory communities in the west. The western mesophytic forest is less dense, has few dominants, and usually lacks the two indicator species of the mixed mesophytic forest (white basswood and yellow buckeye). Within this region, the lower Ohio River flood plain becomes a broad alluvial valley which, at times, is only slightly lower than the rolling oak uplands.

Farther downstream, near Paducah, Kentucky, the Ohio River enters the northernmost extension of the Mississippi Alluvial Plain Section of the Southeastern Evergreen Forest Region. In this alluvial region, three subdivisions of "bottomland forest" are recognized: swamp forest, hardwood bottoms, and ridge bottoms. The swamp forest, consisting principally of cypress and tupelo gum, occupies land on which water stands throughout the year except during extreme droughts. The hardwood bottoms contain a large number of species frequently overflow, and remain covered with water through the late winter and spring. Ridge bottoms contain some of the species of hardwood bottoms, but have a larger number of oaks and hickories. At slightly higher elevations than hardwood bottoms, these areas are covered by water only during floods.

The most extensive of the bottomland forests are the hardwood bottoms. In fact, the entire area has been classified as part of the "Southern Bottomland Hardwood Region." Braun has cited the following characteristic associations (in order of decreasing hydrophytism) within the bottomland hardwood forests in southern Illinois at the northern end of the Mississippi alluvial plain; a maple- elur-pin oak-sweet gum forest, common between the sloughs and well- drained benches; a sweet gum-swamp white oak-pin oak forest in better drained Parts of the bottom land, and a-white oak-hickory-sweet gum forest, which occupies "ridge bottoms" and well-drained benches.

C.22. MAMMALS

The ranges of at least 72 mammals overlap or closely adjoin the Ohio River main stem and its defined operation and maintenance project area. These include at least 8 species of shrews, 3 species of moles, 15 species of bats, 9 species of squirrels, 8 species of mice, 4 species of voles, 6 other species of small mammals and 19 species of various furbearers and other mammals.

Of these 72 species, the ranges of at least 45 overlap the upper Ohio River main stem region within the Pittsburgh Engineer District, which extends from Mile 0.0 at Pittsburgh to Mile 127.2. Within the Huntington Engineer District, which extends from Mile 127.2 to Mile 438.0,

and Louisville Engineer District which encompasses Mile 438.0 to Mile 981.0, at least 65 and 67 species of mammals, respectively, overlap the Ohio River main stem region.

C.23. BIRDS

Many studies have been conducted on the avifauna of the Ohio River during the past 50 to 100 years. During this period, man and time have brought about significant changes in the habitat along the Ohio River. The construction of locks and dams and repeated lumbering have resulted in a change in the level of the river and in the habitat along the Ohio River Valley.

A study of the avifauna in the upper Kanawha Valley illustrates this change by comparing the status of 112 species in 1872 with the status of the same species in 1972. There have been several noted lists of the birds in the Ohio River Valley Region. One such report lists the bird, its status, earliest and average arrival date, latest and average departure date, and a short statement about the species.

Two avian species which once flourished in the Ohio River Valley region, the passenger pigeon (*Ectopistes migratorius*) and the Carolina parakeet (*conuropsis carolinensia*), are now extinct. Other species have been extirpated from the area and many more are showing population declines. It is evident that man's intervention and alteration of the habitat throughout the Ohio River Valley has had a marked effect upon its avian life.

The Ohio River Valley and its tributaries, however, continue to provide habitat for a diverse avian population. There are basically three major habitat types in the Ohio River Region. The first of these is the flood plain forest. Along the Ohio River and its tributaries, the flood plain forests may be subdivided into two basic types. In some cases the forest is characterized by large trees with little understory while in other instances, the understory is a web of grapevines, Virginia creeper poison ivy, and other woody vines. The remaining two habitats may be classified as fallow fields and cropland as well as upland forests. While numerous avian species are permanent residents of the Ohio River region, many other birds can be observed during the fall and spring as they migrate through the Atlantic and Mississippi Flyways.

C.24. AQUATIC RESOURCES

C.24.1. Aquatic Biota Phytoplankton and Zooplankton

Phytoplankton are the plant members of the community of floating or weakly swimming organisms (plankton) suspended in a body of water. Zooplankton are the animal members of the plankton community. Because of their physical characteristics, these microscopic plants and animals are unable to overcome passive transport by currents. In the Ohio River, the phytoplankton constitute a large resource of organic production. They are consumed by zooplankton, benthic organisms, and planktivorous fish, which are in turn consumed by other fishes of the river. Phytoplankton respond quickly to changes in the aquatic environment due to their short generation time, small size, and intimate contact with the surrounding environment. Natural changes, such as caused by seasonal cycles, greatly influence trends in abundance and may either mask or complement changes due to human activities.

Zooplankton are important consumers of phytoplankton and are important food sources for benthos and fishes. Because of their narrow environmental tolerances, small size, and intimate contact with their surrounding environment, zooplankton populations are rapidly influenced by changes in the environment. Zooplankton abundance is influenced by phytoplankton abundance, turbidity, sunlight, hydrologic conditions, temperature, and flow rates. More species and more individuals occur in the summer; lower population levels and varieties of species occur in the winter.

Ohio River zooplankton populations are usually dominated by -rotifers. Cladocerans and copepods (both crustaceans) are also abundant, but are rarely dominant.

C.24.2. Benthos

The benthos consists of those animals which live on or in the river bottom and those which are closely associated with the bottom. Certain benthic species have been described as Indicators of sedimentation, water quality changes, flow rates, seasonal fluctuations, and substrate types. They feed upon phytoplankton, organic matter suspended in the river water, Organic matter deposited within the river sediments, and prey upon each other. The composition of benthic communities is highly dependent upon substrate type. Certain communities composed of specific kinds of organisms inhabit riprap, gravel, and boulder substrates, while others occur only in muddy areas.

In an effort to gather information on bottom fauna within the Ohio River Basin and, through continuing studies, to observe changes from year to year due to water quality, Mason et al. (1971) sampled macroinvertebrate populations at 14 Ohio River and tributary stations over a 5-year period, 1963-1967. Data on macroinvertebrate communities were obtained by dredge and artificial substrate (basket) samples collected at the following Ohio River locations: near Pittsburgh, Pennsylvania (River Mile 9); Toronto, Ohio (River Mile 58); Marietta, Ohio (River Mile 168), which was added in 1966; Addison, Ohio (River Mile 260); Huntington, West Virginia (River Mile 301); Cincinnati, Ohio (River Mile 470); Louisville, Kentucky (River Mile 600); Evansville, Indiana (River Mile 787); and Cairo, Illinois (River Mile 980).

Macroinvertebrate populations in the industrialized upper Ohio River were found to be sparse throughout the years sampled, and were characterized by pollution-tolerant and facultative organisms. However, the number and variety of benthic organisms were observed to increase in the middle and lower reaches of the Ohio River as compared to the upper segment. Macroinvertebrates collected immediately downstream from Pittsburgh, Pennsylvania, consisted principally of bloodworms and oligochaetes, many of which are tolerant of low pH and toxic waste. Pollution-sensitive forms were not found at Pittsburgh, but were collected at sampling points further downstream; caddisflies appeared at Toronto, Ohio; mayflies were present 260 miles downstream at Addison, Ohio; and stoneflies were collected at Huntington, West Virginia. However, few organisms live within the navigation channel proper.

At the conclusion of the 5-year sampling program, Mason et al. provided a provisional "Pollutional Classification of Common Ohio River Macroinvertebrates." Among a total of at least 158 identified taxa, 46 were categorized as "pollution sensitive," 93 were classified as "facultative," and 9 were considered "pollution-tolerant."

C.25. THE HUMAN COMPONENT

Human activities--economic, social, and cultural--have important impacts upon the environment. The study area surrounds the 98C- mile Ohio River Valley which affects the well being of the inhabitants of the six-state area through which it flows. There are seven standard metropolitan statistical areas (SMSAs) along the main stem of the Ohio River. These areas support some 8 million people and their industrial, agricultural, commercial, and recreational pursuits.

C.25.1. Paleontology

The age of the earth is estimated to be 4.5 billion years and the origins of life date to approximately 3.5 billion years ago. Scientists agree that life developed from the simplest form of one-celled creatures and progressed to more complex creatures. Evidence of this progression is sporadically preserved in the paleontological (fossil) record, which consists of the remains or traces of living organisms preserved in the rocks of earth's crust. By studying these fossil remains and their occurrence in the various rock strata, paleontologists can describe the development of life and past environments.

Paleontological sites are occasionally exposed by natural erosion. Also, the mechanical removal of rock during construction of road and railroad beds, strip mines, sand and gravel pits, and stone quarries, frequently exposes paleontological sites. The counties bordering the Ohio River contain paleontological sites with representative fossils ranging from Ordovician (500 million BC) through the Paleocene Epoch of the Tertiary Period (63 million BC). Pennsylvania and West Virginia do not have any known significant paleontological sites in the counties bordering the Ohio River.

C.25.2. Prehistory

Early man relied heavily on the major stream valleys for movement since such valleys generally offered the easiest way from one region to another. The availability of certain basic resources within the Ohio River Basin, such as abundant water food, game, chert, and fertile farmland, attracted human settlement.

The States of Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, and Illinois have collectively recorded a total number of 2,212 archaeological sites within 1 kilometer of the Ohio River and its major slackwater areas. This figure is believed to represent approximately 5 percent of the total archaeological sites located along the Ohio River.

The types of sites that have been recorded include open campsites, village sites, mounds, cemeteries, shell heaps, rock shelters, hamlets, earthworks, petroglyphs, and quarry sites. The prehistoric inhabitants of these sites have been divided by archaeologists into four traditions based mainly on subsistence and technology. These traditions include Paleo-Indian, Archaic, Woodland, and Late Prehistoric.

Nine of the 2,212 recorded sites along the banks of the Ohio River are included on the National Register of Historic Places and 21 have been determined eligible for inclusion. An additional 97 sites are potentially eligible for inclusion. Most of the remaining sites have not been tested or evaluated in terms of National Register Criteria.

-Paleo-Indian Tradition (15,000 BC - 8,500 BC)

Our knowledge of the earliest inhabitants in the Ohio Valley is limited to one rock shelter and surface finds of fluted projectile points. The single known excavated site dating to this period, the Meadowcroft Rockshelter located in western Pennsylvania, has produced stone tools radiocarbon dated, in archaeological context, to ca. 15,000, BC. These tools include an unfluted lanceolate projectile point, flake knives, flake blades, and retouched flakes. Fluted projectile points were manufactured by the Clovis culture from 10,500 BC to 8,500 BC.

Thirty-three recorded archaeological sites along the Ohio River, can be classified as having Paleo-Indian components.

The Paleo-Indian occupation of the Ohio Valley coincided with the terminal stages of the Pleistocene. The cultural pattern during this period is generally believed to be characterized by low population densities and a highly mobile settlement pattern with a subsistence oriented toward the hunting of large, now-extinct mammals in a tundra type environment. There was a preference for high grade cherts from distance quarry sites. The Paleo-Indian tradition was uniform throughout the Ohio Valley until the Late Paleo-Indian Period when regional differences in projectile point styles occurred.

C.25.3. Archaic Tradition (8500 BC – 1000 BC)

In the Ohio Valley the Archaic tradition apparently evolved out of the Paleo-Indian tradition. The Archaic tradition represents a readjustment to new environmental conditions brought on by the retreat of glacial ice and the extinction of a wide range of late Pleistocene fauna. Archaic populations gradually adapted to a deciduous forest environment. They appear to have been substantially larger, and groups of hunter-collectors became less mobile. There was a shift from high grade chert to the utilization of local low quality chert. They hunted deer, small mammals,, fish, and gathered wild plants.

Throughout the Archaic Period there were-changes in projectile point styles and the introduction of new artifacts. During the Middle Archaic Period grooved axes of ground stone were introduced-for heavy woodworking. During the Late Archaic Period, steatite and sandstone bowls were introduced before the introduction of pottery during the Early Woodland Period. There was much regional diversity during the Late Archaic Period and populations can be characterized as having a "harvesting" economy with seasonal hunting activities. The importance of nuts and other plant foods was evident in the presence of nutting stones, mortars, and pestles. Nonutilization objects: large spear points, bannerstones, and stone, bone and shell ornaments are found with human burials in settlements and shell mounds. Dog ceremonialism is evident from dog burials. Marine shell, copper, and high quality chert were traded.

C.25.4. Woodland Tradition (1000 BC - 1000 AD)

The introduction of pottery and horticulture marks the beginning of the Woodland Tradition. Gourd, squash, pumpkin, and sunflower were cultivated. The Adena culture of this period constructed conical burial mounds of earth and stone. Burial Artifacts include: copper beads, bracelets, slate gorgets, and projectile points. The celt replaced the grooved Axe as the heavy-duty woodworking tool.

During the Middle Woodland Period the Hopewell culture attained its zenith in southern Ohio. The Hopewell constructed elaborate earthworks in the shapes of circles, squares, rectangles, and octagons.

These earthworks, generally located on flat river bottoms, ranged in size from a few acres to several hundred acres. Associated with these ceremonial centers were burial mounds similar to those built by the, preceding Adena people. Grave offerings included effigy platform pipes, sheet copper, obsidian, and mica. Trade items found on Hopewell sites in the Ohio Valley included grizzly bear teeth from the Rocky Mountains, galena from Illinois and Missouri, and conch shells from the Gulf Coast.

The Late Woodland Period is characterized by a cultural decline indicated by reduced mound buildings and an end of the elaborate trade networks. There was more regional variation in the Late Woodland Period with a diversity of projectile points and pottery throughout the Ohio Valley. This cultural decline is attributed, by some archaeologists to slightly colder climate that may have affected agricultural production.

C.25.5. Late Prehistoric (1000 AD - Historic Contact)

The Late Prehistoric tradition adapted to a present day climate, development of intensive corn agriculture, planned village life, and the introduction of the bow and arrow. Shell tempered pottery and triangular arrow points were predominant throughout the Ohio Valley. There appears to have been a significant population increase accompanied by warfare throughout the Ohio Valley.

The Lower Ohio Valley was occupied by Mississippian people who built large truncated mounds topped with ceremonial buildings. Fortified villages with bastions and palisades made of logs covered with clay daub were built around these temple mounds. Houses were rectangular with log foundations, wall trenches, and thatched roofs. The settlement pattern also included small farmsteads and hamlets on the flood plains and terraces outside the major village sites.

The Mid-Ohio Valley was occupied by the Fort Ancient people who lived in circular stockaded villages. The village plan consisted of one or two rows of rectangular or circular houses distributed inside a circular stockade wall. The center of the village was an open plaza which was kept free of debris, presumably for ceremonial purposes. Burials were placed in stone slab boxes or simply put in storage or refuse pits inside or near the houses.

The Upper Ohio Valley was occupied by the Monongahela people who also lived in circular stockaded villages. The village plan consisted of one row of circular houses distributed inside a circular stockade wall with an open central plaza. Burials were placed in storage and refuse pits both inside and outside the house walls. The settlement pattern included villages on the flood plain as well as upland villages located along major Indian trails.



US Army Corps
of Engineers

Great Lakes And Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT / PITTSBURGH DISTRICT

Ohio River Main Stem Systems Study (ORMSS)

Integrated Decision Document and Environmental Assessment:

Ohio River Ecosystem Restoration Program

Appendix D:

U.S. Fish & Wildlife Service - DRAFT Report



Restore,
Enhance &
Protect
Terrestrial
Habitats in
the Ohio
River Corridor



Restore,
Enhance &
Protect
Wetland
Habitats in
the Ohio
River
Corridor



Restore,
Enhance &
Protect
Aquatic
Habitats in
the Ohio
River
Corridor

DRAFT

2000

August



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix D:

U.S Fish and Wildlife Service DRAFT Report

August 2000

July 14, 2000

Mr. Tom Swor
U.S. Army Corps of Engineers
Attn: CELRN-PM-P
P.O. Box 1070
Nashville, Tennessee 37202-1070

Dear Mr. Swor:

Enclosed is a copy of the Fish and Wildlife Service's (Service) Draft Fish and Wildlife Coordination Act Report (Report) regarding the development and implementation of an Ohio River Ecosystem Restoration Project Partnership program for the mainstem of the Ohio River. The draft Report outlines the fish and wildlife resources that could benefit from the proposed program and provides recommendations for program design and implementation that we believe would help ensure program success. This draft Report constitutes the report of the Secretary of the Interior, as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The States of Kentucky, Ohio, Indiana, West Virginia, Illinois and Pennsylvania were provided copies of the draft Report for review. Thus far, responses have been received from the States of Ohio, Pennsylvania and Illinois and any comments are incorporated into the enclosed draft Report. You may include our draft Report in your draft Feasibility Report for the Ohio River Ecosystem Restoration Project Partnership program.

The draft Report finds that, with an Ohio River Ecosystem Restoration Project Partnership designed to be conducive to non-federal sponsor participation, habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources on the Ohio River. Since the attached draft Report was prepared, we learned that the preferred alternative has been modified such that it is now quite different from that evaluated in the enclosed draft Report. Changes include revised cost-sharing ratios and additional restrictions on cost-share crediting.

The Service supports authorization of the regionally (locally) preferred alternative. One of the major concerns with implementation of such a program is the cost-sharing ratios. The Service offers the following recommendations with regard to program design and implementation (many of which are included in the regionally preferred alternative):

1. Cost-sharing: Because the program under consideration is a large-scale ecosystem restoration initiative, one cannot rely on the state fish and wildlife agencies, nor on any of the state agencies, to be the main cost-share sponsor, particularly if the cost-share percentage is 65:35 or 75:25. Therefore, the Service recommends the following cost-share components be part of the authorized program:

- 👍 Projects conducted on federal lands will be 100 percent federally-funded.
- 👍 Projects designed to significantly benefit migratory birds and interjurisdictional fishes (Federal trust resources) will be 100 percent federally-funded.
- 👍 Projects designed to benefit species listed as threatened or endangered by the Secretary of the Interior will be 100 percent federally-funded.
- 👍 Project Planning and Design will be 100 percent federally-funded.
- 👍 Minimal cost-sharing (i.e., 10 percent) should be implemented for state and other conservation partners.
- 👍 Funds may be transferred to non-Federal partners or to the Service to allow local administration of projects requiring minimal engineering, e.g., planting trees.

2. Program Design:

- 👍 The authorization should include direction to the Corps to partner with, at a minimum, the Service and State fish and wildlife agencies to conduct an assessment of the health of the Ohio River system to better define program goals.
- 👍 The Corps should be directed to work with, at a minimum, the Service and State fish and wildlife agencies to develop specific goals for the restoration program.
- 👍 Specific goals developed for the Ohio River system should incorporate the goals of other ecosystem-based fish and wildlife conservation plans, such as the North American Waterfowl Management Plan, whenever possible.
- 👍 A long-term monitoring program should be implemented to gauge the success of specific projects and the success of the program. Monitoring should allow the Corps to fine-tune the program in order to maximize benefits to resources.
- 👍 A habitat needs assessment should be undertaken to further refine identified habitat goals, taking into consideration information provided by the long-term monitoring program and new information on Ohio River resources.

The Service would appreciate it if the Corps can provide, in writing, information on the revised alternatives under review by the Corps. The Service's final Report will be revised accordingly.

We look forward to working with the Corps and its non-federal partners in the conservation of fish and wildlife resources in the Ohio River. If you have any questions on this draft Report, please contact Ms. Debbie Mignogno of my staff at 931/528-6481, ext. 209.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

Enclosure

cc: Rock Island FO
 West Virginia FO
 Bloomington FO
 Reynoldsburg FO
 Carterville FRO
 Ohio River Islands NWR
 Ohio Department of Natural Resources
 Kentucky Department of Fish and Wildlife Resources
 Indiana Department of Natural Resources
 Illinois Department of Natural Resources
 Pennsylvania Fish and Boat Commission
 Pennsylvania Game Commission
 West Virginia Division of Natural Resources
 USACOE, Louisville District, Planning Branch (Attn: Richard Hartke)
 USACOE, Huntington District, Planning Branch (Attn: Pete Dodgion)
 USACOE, Pittsburgh District, Planning Branch (Attn: Dave Rieger)

**DRAFT FISH AND WILDLIFE
COORDINATION ACT REPORT**

on the

OHIO RIVER ECOSYSTEM RESTORATION

PROJECT PARTNERSHIP PROGRAM

by

**DEBORAH MIGNOGNO, MIKE LITWIN,
BARBARA DOUGLAS, PATRICIA MORRISON,
KEN LAMMERS AND JOYCE COLLINS**

for

**U.S. Fish and Wildlife Service
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May 2000

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I. EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (Corps) developed the proposed Ohio River Ecosystem Restoration Project Partnership Program, in cooperation with the U.S. Fish and Wildlife Service and the states of Illinois, Indiana, Ohio, Kentucky, West Virginia and Pennsylvania. The Partnership Program would partner with other Federal and non-Federal entities to restore, enhance, and protect fish and wildlife abundance, diversity, and habitats within the Ohio River watershed. With the Ohio River Ecosystem Restoration Project Partnership, assuming that it is designed to be conducive to non-Federal sponsor participation, additional habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources on the Ohio River.

The Program under consideration is a large-scale ecosystem restoration initiative. One of the major concerns with implementation of such a program is the establishment of a cost-sharing ratio. One cannot rely on the state fish and wildlife agencies, nor on any of the state agencies, to be the main cost-share sponsor, particularly if the cost-share percentage is 65:35 or 75:25.

The Service supports the goals and objectives outlined in the plan; that is, the restoration, enhancement and protection of important terrestrial, wetland, and aquatic habitats in and around the Ohio River corridor. With the Ohio River Ecosystem Restoration Project Partnership, assuming that it is designed to be conducive to non-Federal sponsor participation, additional habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources. However, without careful evaluation of proposed site-specific projects for potential undesirable secondary or indirect effects, an individual activity could have undesirable effects.

The Service offers the following recommendations that should allow the Program to proceed and meet its objectives:

- 👍 Projects designed to significantly benefit migratory birds and interjurisdictional fishes (species determined to be national in character) should be 100 percent federally funded.
- 👍 Projects designed to benefit species listed as threatened or endangered by the Secretary of the Interior should be 100 percent federally funded.
- 👍 Project Planning and Design should be 100 percent federally-funded.
- 👍 Funds may be transferred to non-Federal partners or to the Service to allow local administration of projects requiring minimal engineering, e.g., planting trees.

Further, to insure the success of the Program, the following should be components of the Program:

- ☝ The Corps should work with, at a minimum, the Service and State fish and wildlife agencies to develop quantifiable goals for the restoration program.
- ☝ Specific goals developed for the Ohio River system should incorporate the goals of other ecosystem-based fish and wildlife conservation plans, such as the North American Waterfowl Management Plan, whenever possible.

II. PURPOSE, SCOPE AND AUTHORITY

The U.S. Army Corps of Engineers (Corps) proposes to develop and implement an Ohio River Ecosystem Restoration Project Partnership Program. The Program would partner with Federal and non-Federal entities to restore, enhance, and protect fish and wildlife abundance, diversity, and habitats within the Ohio River watershed.

The purpose of this report is to discuss the Corps' proposed implementation of an Ohio River Ecosystem Restoration Project Partnership Program, its related impacts to fish and wildlife resources, and what measures can be taken to avoid or minimize adverse impacts. This report constitutes the report of the Secretary of the Interior, as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

III. INTRODUCTION/BACKGROUND

A. Prior and Ongoing Ecosystem/Mainstem Studies on the Ohio River

Through its Fish And Wildlife Coordination Act responsibilities, the Corps established a coordination process with the State Fish and Wildlife agencies, the U.S. Fish and Wildlife Service and the Environmental Protection Agency. This "Interagency Environmental Team" began to meet quarterly in 1997 to identify environmental concerns and opportunities related to the Corps' Ohio River Mainstem Systems Study.

As part of the study process, the Corps and the Service participated in state-by-state meetings with the various state natural resource agencies during the summer of 1998 to identify potential habitat restoration projects within the Ohio River mainstem corridor that could be funded through such existing environmental restoration authorities as Section 1135 of the Water Resources Development Act (WRDA) of 1986 ("Project Modifications for the Improvement of the Environment"), Section 206 of WRDA 1996 ("Aquatic Ecosystem Restoration"), and Section 204 WRDA 1992, as amended ("Beneficial Uses of Dredged Material"). During that same time, the Corps and the Service briefed the directorate of each of the three Service Regional Offices

(Regions 3, 4 and 5) whose area of responsibility includes part of the Ohio River mainstem area. In addition, the Corps and the Service briefed the Environmental Protection Agency's NEPA compliance personnel for EPA Regions 2, 3, and 4. These briefings addressed the study of future navigation needs as well as the development of ecosystem restoration projects associated with the study.

Due to the large number of potential habitat restoration projects identified, the Corps identified a need for a separate Ohio River Habitat Restoration Partnership Program.

1. Past Studies

Fish and Wildlife Resources of the Ohio River Basin (included as Appendix "G" in the Ohio River Basin Comprehensive Survey - (USFWS undated) The Service's report analyzed the fish and wildlife resource problems in the Ohio River Basin and furnished general solutions, especially as related to potential water development projects.. The report also included the related needs of the present and future sportsmen of the area.

The Service's 1980 Planning Aid Report Gallipolis Locks and Dam Replacement Study (USFWS 1980) discusses the high quality fish and wildlife resource areas within the primary study area. The study area included the Greenup and Gallipolis Navigation Pools on the Ohio, Kanawha, and Big Sandy Rivers.

The Service's 1985 Final Fish and Wildlife Coordination Act Report, Lower Ohio River Navigation Study, Kentucky-Illinois (USFWS 1985a) describes existing fish and wildlife resources of the Ohio River from the mouth of the Cumberland River (RM 920) to its confluence with the Mississippi River (RM 981). The report identifies potential impacts to these fish and wildlife resources from project alternatives; recommends project modifications to avoid and/or minimize these impacts, and outlines various mitigation needs associated with the project.

The Service's 1986 Planning Aid Report for the Fish and Wildlife Resources of the Upper Ohio River (USFWS 1986a) describes existing fish and wildlife resources of the Ohio River from Pittsburgh (mile 0.0) to the Pennsylvania-West Virginia-Ohio border (mile 40.0). The report focused on the results of fish sampling efforts undertaken in the summer of 1985 and on the ecologically significant areas, including wetlands, that could be affected by rehabilitation of the existing Emsworth, Dashields and Montgomery Locks and Dams.

The Service's 1989 Final Environmental Assessment for the Ohio River Islands National Wildlife Refuge Proposal (USFWS 1989) outlined the various threats to important fish and wildlife resources within the study area. It analyzed various alternatives for long-term protection of important habitats, including land acquisition by the Service.

The Service's 1991 Reconnaissance Stage Planning Aid Report for the Uniontown Locks and Dam Study (USFWS 1991a) provided preliminary information concerning fish and wildlife resources that occur within the area of project influence and identified resources issues and concerns that could be addressed by the ongoing study.

The Service's 1993 Final Fish and Wildlife Coordination Act Report for the Olmsted Locks and Dam Project (USFWS 1993) was a supplement to the FWCAR report released to the Corps in 1985. The report evaluated changes in project design since the above 1985 report and their potential for impacts to Federal trust fish and wildlife resources.

The Service's November 10, 1999, Draft Fish and Wildlife Coordination Act Report for J.T. Myers and Greenup Locks Improvements (USFWS 1999) provided information concerning fish and wildlife resources occurring within the project area as well as fish and wildlife resources within the Ohio River mainstem system. The report outlined ongoing impacts to these resources, and predicted reduced or additional impacts as a result of project implementation. In that report, the Service also discussed the proposed restoration program and offered suggestions that the Service believed would allow the Program to proceed and meet its objectives.

2. On-going studies

Ohio River Valley Ecosystem (ORVE) Strategic Plan - The Service's Ohio River Valley Ecosystem Team has developed and implemented a Strategic Plan for Conservation of Fish and Wildlife Service Trust Resources in the Ohio River Valley Ecosystem. The Team's eight Sub-groups are the primary mechanisms for conducting activities on the ground. The Sub-groups were formed on the basis of the resource priorities outlined in the Strategic Plan: native aquatic mollusks; migratory land birds and other bird species of concern; native fishes; karst/cave habitat; wetland, riverine, and riparian habitat; listed/proposed threatened and endangered species, candidate species and species of concern; land conservation; and, fish and wildlife-oriented recreational use. The mollusk and the native fishes subgroups have developed conservation plans for their species groups.

ORVE GAP Migratory Bird Resource Priority GAP Metaproject - This project will identify areas of importance within the Ohio River Valley Ecosystem to species of migratory birds. Target bird species include songbirds that winter in South America or Latin America and breed or inhabit the ORVE during the spring and summer. Both Partners in Flight and the Service personnel believe that these species are in particular danger due to stress caused by fragmentation and loss of habitat in both their wintering grounds and their spring and summer ranges. Loss of habitat and fragmentation have a number of effects upon a species and many of these are currently being studied. The purpose of the project is to identify areas in the Ohio River watershed that are of particular importance to these species of birds and present the information in an ArcView GIS format.

North American Bird Conservation Initiative (NABCI-US) - In the United States, the goals of this project are to bring together the bird initiatives already underway, including: North American Waterfowl Management Plan, Partners in Flight, U.S. Shorebird Conservation Plan, and the North American Colonial Waterbird Conservation Plan. Recognizing that the conservation interests of these initiatives can be better served through more integrated planning and delivery of bird conservation, the vision of NABCI-US is to "achieve regionally-based, biologically-driven, landscape-oriented partnerships that deliver the full spectrum of bird

conservation across the North American continent and that support simultaneous, on-the-ground delivery of conservation for all birds.” (North American Bird Conservation Initiative (NABCI): Strategy and Action Plan, May 1999, <http://www.bsc-eoc.org/nabci.html>).

The U.S. Shorebird Conservation Plan. - The development of this plan is a collaborative effort between researchers, land managers and education specialists from the U.S. who will cooperate with colleagues from Canada and Mexico to advance effective conservation of North American shorebird species. The shorebird plan partnership has participated actively in the development of NABCI-US. The Plan, coordinated by Manomet Center for Conservation Sciences, focuses on three main components: 1) habitat management, 2) research and monitoring and 3) education and outreach. National working groups as well as smaller task groups and regional working groups were established to address issues in each of these areas. There are basically two planning areas which include portions of the Ohio River mainstem area: Central Hardwoods and Appalachian Mountains. The Central Hardwoods area is included within the Upper Mississippi Valley/Great Lakes Regional Plan; there will not be a regional shorebird conservation plan prepared for the Appalachian Mountains area.

North American Colonial Waterbird Conservation Plan - The North American Colonial Waterbird Conservation Plan will guide the maintenance of healthy populations, distributions, and habitats of colonial-nesting waterbirds in North America throughout their breeding, migratory, and wintering ranges. This can be achieved through creation of a cohesive, multi-national, partnership for conserving and managing colonial-nesting waterbirds (seabirds, wading birds, terns, gulls) and their habitats throughout North America. The Plan will be developed in concert with other bird conservation planning efforts underway.

North American Waterfowl Management Plan - In 1986, the North American Waterfowl Management Plan goals were to protect and restore 6 million acres of wetlands habitat (USFWS 1986b). The 1994 Plan update (USFWS 1994a) calls for 11.1 million acres of wetlands and associated uplands to be protected and 14.7 million acres to be restored or enhanced. As in the original Plan document, the goal of restoring continental waterfowl populations to numbers seen in the 1970's remains the same. Transforming the goals of the Plan into on-the-ground actions relies on partnerships called joint ventures. Joint ventures are comprised of individuals, corporations, conservation organizations, and local, state, provincial, and Federal agencies. There are currently 10 habitat joint ventures in the United States and 3 in Canada.

Within the project area, there are 3 joint ventures whose areas of concern partially include sections of the Ohio River mainstem: Lower Mississippi Valley Joint Venture; Atlantic Coast Joint Venture, and Upper Mississippi River-Great Lakes Region Joint Venture.

Partners in Flight - One of the primary activities being conducted by Partners in Flight (PIF) - U.S. is the development of a bird conservation plan for every physiographic area or state in the United States. This is being coordinated through the PIF Regional Coordinators and the PIF Regional Working Groups. Within the project area, there are two Partners in Flight physiographic areas for which bird conservation plans will be prepared: Interior Low Plateaus and Ohio Hills.

The bird conservation plans are formulated around the premise that focused, cooperative, and voluntary habitat conservation on a landscape level is the key to bird conservation. A concentration on habitat will improve conditions for all birds, whether migratory or resident, endangered or common, game or nongame, and will contribute to the protection of other animals, plants, and communities.

The bird conservation plan for the Interior Low Plateau is completed and being implemented; the Ohio Hills plan is in preparation. These plans will identify the species and habitats most in need of conservation actions. Priorities are set within biologically appropriate conservation planning units. Within a planning unit, each species is prioritized according to a set of criteria including population trends, size of geographic range, and threats on the breeding and nonbreeding grounds. The plan will then establish population and habitat conservation objectives. It will describe the habitat conditions and management practices favorable to priority species or species suites and set objectives for the nature, extent, and distribution of favorable habitat conditions or populations of priority birds.

B. General Description of the Study Area - The Ohio River

The Ohio River begins at the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania. After leaving Pennsylvania, the Ohio River forms the border of West Virginia and Kentucky with Ohio, and of Illinois, Indiana and Ohio with Kentucky. The River travels 981 miles before its confluence with the Mississippi River. The Ohio River has a constricted channel upstream of Louisville, Kentucky (RM 606); however, small floodplains are common within portions of this area. Downstream from Louisville, the Ohio River becomes a floodplain river (Thorpe 1992). The drainage area for the Ohio River Basin totals 203,940 square miles, including the Tennessee and Cumberland River drainages. The drainage area encompassed by Ohio River tributaries with drainage areas 1,000 square miles or more is 182,370 square miles, or 89.4 percent of the total drainage area.

1. Human Use of the Ohio River

The location of the Ohio River made it important as a route to the west and a transportation route to the sea. Agricultural lands attracted the first settlers and today the western portion of the basin is part of one of the most important agricultural regions in the U.S. The early settlers cleared the forests and drained many of the wetlands between 1800 and 1900 (Pearson and Pearson, 1989). One of the major effects of this clearing and draining was siltation into the river from the erosion of soils from the cleared fields and pastures.

A joint committee of the Ohio Valley states met in 1819 for the purpose of improving the Ohio River for navigation. The commission mapped 102 obstructions between Pittsburgh, Pennsylvania, and Louisville, Kentucky. In 1824, Congress passed the General Survey Act,

which gave the U.S. Corps of Engineers continuing authority for navigational studies. In 1827, Congress passed the first Rivers and Harbors Act to authorize Federal removal of river obstructions and improve harbors. Removing snags and dredging sand bars were popular means of navigation improvement. The first Federal dam on the Ohio River was built in 1838 at Brown's Island to divert the river around one side of the island. The first navigation lock was built 5 miles below Pittsburgh at Davis Island in 1885 to create a harbor at Pittsburgh which could hold 12,000 boats and barges. At one time, there were 54 wicket dams in operation on the Ohio River. With completion of Olmsted Locks and Dam, currently under construction, all of the wicket dams will have been replaced by a series of 19 lock and dam projects, predominantly with high-lift dams. Presently, the Ohio River mainstem is maintained by the Corps as a series of 20 relatively flat pools to provide for year-round navigation.

2. Water Quality

With industrialization of the Ohio River valley, water quality of the river began to degrade because of the combination of waste loadings from the manufacturing processes and the increased population pressure that followed the industrial boom (Cavanaugh and Mitsch 1989). However, the lower 150-200 miles of the River was not polluted as badly, since fewer people lived along that portion of the river and several large tributaries provided additional dilution. The water quality of the Ohio River continued to deteriorate and was at its worst during the droughts that occurred in 1930-31 and 1934 (Pearson and Krumholz 1984).

In 1948, the governors for the states along the Ohio River established an interstate Ohio River Valley Water Sanitation Commission (ORSANCO) to fight the growing water pollution problem in the Ohio River. As a result of this effort, a valley-wide educational program was started, new state laws were passed, industrial committees set control standards for industrial wastes, and many new pollution control installations were made (ORSANCO 1998).

During the period 1973 to 1985, Van Hassel et al. (1988) found decreased numbers of pollution-tolerant fish species, and increased numbers of more pollution-intolerant species, indicating improvement in the water quality and fishery of the Ohio River. Ohio River sediment samples taken in 1987 generally had lower concentrations of cadmium, chromium, copper, iron, lead, nickel and zinc, and higher values for manganese than did sediment samples taken in 1977 (Youger and Mitsch 1989). Although there were some reductions in the concentrations of metals, concentrations generally remain well above background and may be a source of water contamination in the Ohio River for the future (Youger and Mitsch 1989).

Trends in Ohio River water quality indicate increasing concentrations of chloride, pH, suspended sediments and arsenic, and decreasing concentrations of sulfate, dissolved oxygen deficit and lead. Atmospheric deposition is suggested as a causal factor for the changes in nitrate, lead, arsenic and cadmium concentrations. Municipal waste treatment, use of highway salts and nitrogen fertilizer and regional trends in coal combustion are suggested as other significant influences on the water quality of the Ohio River (Cavanaugh and Mitsch 1989).

More recent data collected by ORSANCO between 1980-1990 for total phosphorus, nitrate/nitrite nitrogen, and ammonia nitrogen indicates either no change or decreasing concentrations in nutrient parameters at most of the 16 Ohio River sampling locations. However, nutrients have been identified as a concern on Ohio River tributaries. (Heath et. al unpublished).

The Ohio River basin constitutes approximately 20 percent of the Mississippi Watershed, and contributes about 35 percent of the Mississippi River's total flow at its entrance to the Gulf of Mexico. Approximately one-third of the land area of the basin is classified as cropland. Preliminary data indicate that a significant amount of nutrients delivered to the Gulf come from the upper Mississippi and Ohio River watersheds. Interim results indicate that the Ohio River basin contributes an average annual nitrogen load of 311 million kg/yr (estimated) to the Mississippi River. Major direct tributaries to the Ohio River monitored by ORSANCO account for approximately 85 percent of the total nitrogen load. Point sources account for approximately three percent of the total nitrogen load in the Ohio River (Heath et al. unpubl.)

The presence of a zone of hypoxia in the Gulf of Mexico, which poses a threat to aquatic communities commercial fisheries, has been associated with nutrient loads from the Mississippi River basin. This oxygen-depleted zone occurs in bottom-waters covering a large, variable-sized area of the Gulf extending from the mouth of the Mississippi River, westward along the coast, towards the Texas border. Excess nitrogen and other nutrients from the Mississippi River basin leads to increased algae production in the Gulf. It is suggested that the excess nutrients entering the Gulf from the Mississippi River basin causes increased algae production which, in turn, exerts an increased oxygen demand resulting from their decay after die-off (Heath et al. unpubl.).

The impacts of expanding Gulf hypoxia, either currently documented or potential, include: altered coastal phytoplankton based food webs; noxious algal blooms; altered benthic ecosystems; reduced economic productivity in both commercial and recreational fisheries; and both direct and indirect impacts on fisheries such as direct mortality and altered migration which may lead to declines in populations and landings (Heath et al. unpubl.).

IV. FISH AND WILDLIFE CONCERNS AND PLANNING OBJECTIVES

Protection of fish and wildlife resources will require the long-term maintenance of healthy ecosystems which, in turn, will require a holistic view of resource conservation, recognizing that all things are connected. To be effective, an ecosystem approach will not only mean protecting or restoring the function, structure, and species composition of an ecosystem, but also factoring in the impacts of and providing for sustainable socioeconomic activity.

The unusually rich and diverse fauna found in the Ohio River watershed is the product of a multitude of biotic and abiotic factors which have evolved over time. Throughout geologic

time, changes in such factors as topography, climate, and geomorphology have formed, modified, and eliminated habitats and consequently have had a profound effect upon the distribution of the faunal assemblages in the watershed. Due to the watershed's central geographical location in the eastern United States, some species with northern affinities and others with southern affinities occur in the watershed in addition to those common to the central region of the country.

Environmental alteration and degradation are continuing challenges to the maintenance of a productive and healthy watershed. Resources of the Ohio River watershed are threatened by land conversion, poor land-use practices, direct and indirect physical alteration of the area's rivers and streams, acid mine drainage, destruction of wetland habitats, and both point- and nonpoint-source discharges of pollutants. Herbicides, insecticides, nutrients, and sediment are significant components of the agricultural runoff that adversely affect aquatic systems in the Ohio River watershed. Acid precipitation and other airborne pollutants are having dramatic effects on aquatic and terrestrial communities. Natural resources are further threatened by an expanding human population and its increased demand for both renewable and nonrenewable resources. Contamination of both aquatic and terrestrial systems through acid mine drainage and the accidental release of toxic chemicals is a continuing threat. Continued operation and maintenance of the inland navigation system and the recent invasion of the nonindigenous zebra mussel are having significant adverse impacts on native flora and fauna of the watershed's rivers and streams. Other nonindigenous species are threatening native components of aquatic and terrestrial systems throughout the watershed. The expansion of urban and suburban areas within the Ohio River watershed and the concurrent loss of forest, wetlands, agricultural lands, and other types of open space associated with this expansion have reduced the quantity and quality of natural habitats available to fish and wildlife.

A. Loss of Riverine Habitat Diversity

Historically, the Ohio River contained long, shallow riffle/shoal areas (such as the Falls of the Ohio), shallow island back channels and overflow sloughs. These important habitat types were mostly lost when the river was impounded. Islands, another important habitat type, still remain, but there are fewer in number and many suffer from shoreline erosion and side-channel sedimentation. Most tributary mouths have been converted by impoundment to embayments, usually of lesser quality than natural backwaters. Many of these are silted in through a combination of sediment input due to adjacent and upstream landuse and navigation-related alterations in river flow regimes which prevent or reduce natural flushing of sediments into the Ohio River mainstem.

Objective: Enhance Riverine Habitat Diversity in the Ohio River

Opportunities:



Target projects that create spawning shoals. In some instances, natural spawning shoals may be restored. In addition, artificial shoals can be created at appropriate locations

which do not interfere with navigation. Other artificial structures can be used to create structural habitat, cover and low-velocity areas.

- 👍 Target projects that will enhance backwater habitat quality.
- 👍 Target projects that will restore flow to silted side channels, to maintain shallow open water while providing quiet, backwater habitat.
- 👍 Target projects that create vegetated shallows both in the mainstem Ohio River and in selected embayments through vegetation planting and construction of shallow protective dikes (if necessary). These habitat types are used by several fish species for spawning and nursery areas. They are also used by waterfowl and wading birds.
- 👍 Stabilize eroding shorelines on the river bank and on islands. Where conditions permit, stabilize eroding shorelines by a combination of armoring, removal or placement of submerged dikes (where appropriate) and tree plantings.

B. Obstruction of Fish Movements

Dams prevent migratory/highly mobile fish species from moving freely throughout the river to exploit the variety of habitats necessary for different parts of their life cycles. Lock chambers and high flows facilitate fish passage to some extent, but their operation is generally not designed to facilitate fish passage, and passage may not be available at critical times in the life cycles of migratory fishes. In addition, freshwater mussels have an obligate parasitic stage during which they are attached to the gills of a specific host species of fish. These mussel species are dependent on their host fish for early development and dispersal throughout their natural range. If host fishes are prevented from moving upstream or downstream during critical life stages of mussel reproduction and development, then this mechanism of development and dispersal is disrupted.

Objective: Facilitate Between-pool Movement of Fishes on the Ohio River

Restoration opportunities:

- 👍 In partnership with the Service and other agencies, initiate a study that will identify Ohio River migratory fish species and associated mussels and describe the average seasonal opportunities for upriver movement of migratory fish species on the Ohio River and the potential consequences, if any, of dams on fish and mussel fauna in the Ohio River. This study could be accomplished through: obtaining information on spatial and temporal migratory patterns and swimming abilities of these fish species; compiling information on migratory fishes in the Ohio River and the seasonal timing of fish movements within the Ohio River; evaluating migration behavior with respect to migration purpose; obtaining information of fish travel pathways and swimming performance; estimating hydraulic conditions at dams using data on dam designs; compiling information on dam operations and standard hydraulic engineering equations; describing average water

velocities as a function of head; determining average water temperatures as they relate to migration timing/spawning period; compiling models of critical velocity for sexually mature fish; and predicting the average head at dams by week of the year based on historical water elevations.

- 👉 If warranted, modify lock chamber management to facilitate fish passage at key times. This could be based on the results of the study described above. Or, a demonstration project could be initiated with appropriate monitoring of success.
- 👉 Explore other alternative methods of fish passage, if warranted.

C. Bottomland Forest/Riparian Forest

In the Ohio River floodplain, a typical habitat structure was a matrix of bottomland forest interspersed with components of other wetland types such as sloughs and oxbows. Much of this habitat has been drained and cleared for agriculture, leaving the remainder highly fragmented; however, several high-quality natural areas remain.

Objective: Enhance Bottomland Forest and Riparian Forest Along the Ohio River

Opportunities:

- 👉 Target projects which would create significant contiguous areas of bottomland forest and riparian forest as a means of increasing fish and wildlife habitat and reducing habitat fragmentation.
- 👉 Target projects which would create large contiguous areas of palustrine emergent wetlands. Emergent wetlands are used by a large variety of water birds and other wetland wildlife.

D. Physical Impacts and Pollution from Barge Traffic and Barge Fleeting

Barge traffic impacts on aquatic biota is a subject that has been studied extensively by the Corps and others (Gloman 1984, Miller et.al. 1997). Major impact types have been identified, however the extent of impacts has not been extensively analyzed, and is probably dependent upon season, flow stage, and local conditions. In general, impacts include entrainment of planktonic and mid-water eggs and larvae through propellers, propeller-related adult mortality; winter mortality of fish dislodged from velocity shelters, disruption of shoreline fish nesting by barge wakes, siltation on mussels and other benthic biota, spills of pollutants from barges and loading docks, and direct physical impacts of barges and propeller thrust on benthic biota, especially mussels. In addition, beds of aquatic vegetation are impacted due to constant turbidity and re-suspension

of nearshore sediments, which retards light penetration and prohibits germination of many submerged aquatic plants.

There are many barge fleeting areas in many areas of the mainstem Ohio River, mostly associated with electrical generating stations (coal), producers of rock and gravel products, and commercial ports. Since most fleeting is in shallow shoreline areas, substantial impacts can occur to mussel beds and shoreline fish spawning habitat when these fleeting areas are developed and dredged. Physical impacts of tow traffic is intensified around these areas.

Objective: Minimize Physical Impacts and Pollution from Barge Traffic and Barge Fleeting

Restoration opportunities (opportunities to reduce impacts from main channel barge traffic are limited, but the following measures could be implemented):

- 👉 Install mooring cells or buoys at critical locations so that barges can avoid temporary mooring over mussel beds or against identified shoreline areas.
- 👉 Install markers around shallow mussel beds to reduce direct impacts of tow traffic.
- 👉 Provide the commercial navigation industry with charts showing the location of mussel beds and other sensitive resources, with information concerning why these resources should be avoided.

E. Loss of Stream Habitat Quality in the Lower Reaches of Tributary Mouths

Tributary mouths have been transformed by impoundment from stream environments to lake-like environments, often for several miles of the stream's lower reaches. While embayments have been formed in most tributary mouths, their configuration has induced construction of recreational marinas which degrade habitat through intensive boat use and introduction of petroleum pollutants. A number of embayments have silted in due to agricultural soil runoff and lack of flow velocity resulting from impoundment. Additionally, silt is often deposited at the embayment mouths during periods of high flow on the mainstem Ohio River.

Objective: Enhance Stream Habitat Quality in the Lower Reaches of Tributary Mouths

Restoration Opportunities:

- 👉 Target projects that will reforest the lower reaches of tributaries to reduce siltation into the embayments and create valuable wildlife habitat.

- 👉 Target projects that will restore or enhance wetlands in the upper ends of tributary embayments to reduce siltation and create valuable fish and wildlife habitat.
- 👉 Target projects that change flows such that silt deposition at an embayment mouth is reduced or avoided.

F. Freshwater Mussels in the Ohio River

The primary causative factor in the decline and present endangered status of freshwater mussel species is loss of habitat. A number of agencies are presently working to develop techniques for artificial propagation of mussels. However, successful propagation of mussels in laboratories will not contribute to the recovery of species unless there is suitable habitat available in which to place them.

Objective: Restore Significant Native Mussel Populations in the Ohio River

Restoration Opportunities:

- 👉 The Corps should continue to investigate the feasibility of creating mussel habitat in the Ohio River and/or in the lower reaches of its tributaries in areas that presently or historically supported mussel populations. The possibility of creating side channels with continuous flow and suitable substrate below existing dams, or creating artificial “islands” with back chutes, will be explored.

V. NO ACTION ALTERNATIVE/FUTURE WITHOUT PROJECT CONDITIONS

The “no action alternative” maintains the status quo, which is the pursuance of some restoration projects through existing Corps authorities. Existing Corps authorities include Section 1135 of the Water Resources Development Act (WRDA) of 1986; Section 204 of WRDA 1992 and Section 206 of WRDA 1996. Individual agencies could undertake some of these projects independently; however, by combining funds, more ambitious or large-scale projects can be implemented that would otherwise not be undertaken. Existing authorities generally do not provide for large-scale, system-wide restoration efforts. Although these authorities have been available for use within the Ohio River mainstem area for a number of years, they have been used sparingly.

It is recognized that projects undertaken under the above authorities and other habitat restoration authorities of other Federal agencies can contribute to the goals identified for the Ohio River

corridor by the restoration partnership. However, none of these alone, or in combination, fully focus on and fulfill the need for comprehensive Ohio River ecosystem consideration. Each is designed for a different purpose, and many are targeted to relatively narrow resource issues. Further, the combination of discrete projects undertaken through a variety of different authorities does not constitute a comprehensive approach for maintaining and improving a complex and extensive ecosystem such as the Ohio River corridor.

VI. OHIO RIVER ECOSYSTEM RESTORATION PARTNERSHIP PROGRAM WITH THREE FUNDING ALTERNATIVES

The Corps proposes to develop and implement an Ohio River Ecosystem Restoration Partnership Program with a proposed authorization of \$200 million over a period of 15 years, with a maximum Federal funding of \$10 million annually, for each of the first five years, and \$15 million annually for the remainder of the Program. The purposes of the proposed ecosystem restoration program are outlined to restore, enhance, and protect fish and wildlife abundance, diversity and habitats negatively impacted by human activities within the Ohio River watershed.

The goals of the proposed Program and strategies to meet those goals are outlined in the Ohio River Ecosystem Restoration Partnership Program Ecosystem Restoration Plan (Appendix A), developed in partnership with the various conservation agencies of the six states bordering the mainstem Ohio River (Illinois, Indiana, Kentucky, Ohio, West Virginia, and Pennsylvania) and the Service. The plan outlines three goals:

- 👍 restoration, enhancement and protection of wetland habitats along the Ohio River corridor;
 - 👍 restoration, enhancement and protection of important terrestrial habitats adjacent to the Ohio River; and,
 - 👍 restoration, enhancement and protection of aquatic habitats within the Ohio River.
- The Corps estimates that the proposed Program, with implementation of the preferred alternative (see below), would: create/restore an estimated 15,000 acres of bottomland hardwood forests; restore/enhance 1,250 acres of embayment aquatic habitat; restore and protect 40 islands; restore and protect 25 miles of shoreline habitat; and result in an unquantified amount of wetlands restored/enhanced and mainstem aquatic habitat restored/enhanced.

The proposed Program would include construction of recreational, educational and low-cost sanitary facilities that are compatible with the ecosystem restoration projects and enhance the experience of the site's natural values. The cost of the facilities would not exceed 10 percent of the total project cost.

Alternatives Considered: Cost-Sharing Contributions

Three cost-sharing alternatives were developed by the Corps. These alternatives will not only impact Federal and non-Federal expenditures, but will likely influence the total number of ecosystem restoration projects that are implemented within the context of the proposed Program.

Plan 1: Cost-sharing to be implemented would be 65 percent Federal and 35 percent non-federal costs. The maximum Federal cost for any one project would be \$5 million. Total funds to be authorized over 15 years would be \$200 million. The program would be funded at \$10 million per year for the first five years, with \$15 million per year funding for the remaining 10 years.

Plan 2 (Preferred Alternative): Cost-sharing to be implemented would be 75 percent Federal and 25 percent non-Federal costs. The maximum Federal cost for any one project would be \$5 million. Total funds to be authorized over 15 years would be \$200 million. The program would be funded at \$10 million per year for the first five years, with \$15 million per year funding for the remaining 10 years.

Plan 3: Cost-sharing to be implemented would be 90 percent Federal and 10 percent non-Federal costs. The maximum Federal cost for any one project would be \$5 million. Total funds to be authorized over 15 years would be \$200 million. The program would be funded at \$10 million per year for the first five years, with \$15 million per year funding for the remaining 10 years.

Other Cost Sharing Provisions Included in Plans 1, 2 and 3

- 👍 The non-Federal sponsor shall provide 100 percent funding for lands, easements, rights-of way, utility or public facility relocations, and dredged or excavated material disposal areas (LERRD). The value of LERRD shall be included as part of the non-Federal cost share. Where the LERRD exceeds the non-Federal cost share, the sponsor will be reimbursed for the value of LERRD which exceeds their cost share requirements.
- 👍 The non-Federal sponsor is responsible for 100 percent of the cost of operation, maintenance, repair, rehabilitation and replacement of project features.
- 👍 The entire non-Federal share of the total project cost may be credited as work-in-kind.

- 👍 For ecosystem restoration projects implemented on Federal lands, restoration projects would be fully funded with Federal appropriations.
- 👍 Projects will be 100 percent federally-funded for activities designed to significantly benefit species that have been listed as threatened or endangered by the Secretary of the Interior.
- 👍 A reduced cost share, with a sponsor contribution of 10 percent, would be applied for those projects providing significant benefits to other species determined to be national in character, such as migratory birds and inter-jurisdictional fish.
- 👍 Funding may be transferred to the Service for implementation of small projects, such as forest or prairie restoration, which do not require complex engineering capabilities.
- 👍 State agencies may use other Federal funds, appropriated for ecosystem improvement, as non-Federal matching funds for cost sharing purposes.

Finally, all three plans include provisions for the Corps to initiate a long-term habitat needs assessment and monitoring program to assess the health of the Ohio River corridor; continually refine program goals based on new information or changes in the system; and monitor constructed projects to gauge the success of the program. Monitoring will allow partners to fine-tune the program in order to maximize benefits to resources. Using this process, the Corps and its sponsors will be able to better identify environmental needs as changes occur within ecosystem habitats. The cost of this monitoring program will be fully funded with Federal appropriations.

VII. FISH AND WILDLIFE RESOURCES WITHIN THE PROJECT AREA

Previous alterations to the Ohio River as a result of dam construction and operations and maintenance of the river for navigation traffic have resulted in permanent alterations to the structure and function of the river and the surrounding habitat. Cumulative impacts from human activities including direct habitat loss through development and floodplain encroachment, pollution, bank erosion and siltation of embayments, increased use of the river for water supply, recreation, navigation, etc. These impacts continue to accrue and degrade the quality and quantity of remaining habitat. Conversely, water quality improvements, mainly due to the passage of the Clean Water Act, have allowed many species to begin to recover from previous impacts and to decolonize areas that were previously unsuitable. Although habitat encroachment will continue, benefits derived from improved water quality, if not coupled with other improvements, will likely plateau.

B. Ohio River Fish

The fish community of the Mississippi Drainage is exceptionally rich in species, harbors many ancient or relic forms, contains several evolutionary lines not found elsewhere in the world, and represents the center of adaptive radiation for freshwater fishes in North America (Pearson and Pearson 1989). The large rivers are generally inhabited by a distinctive assemblage of fish species. Shovelnose sturgeon, paddlefish, skipjack herring, river shiner, goldeye, silverband shiner, and blue sucker are characteristic of the large river fishes found in the Ohio River.

The series of locks and dams constructed on the Ohio River mainstem had, and continue to have, a strong influence on Ohio River fish communities. For example, many of the dams have inundated and facilitated siltation of extensive reaches of clean gravel or rubble substrate. This coarse substrate provided the predominant lithophilic fishes (fishes which spawn over clean gravel-rock) with their preferred spawning substrate, which is now in reduced supply.

The Louisville District developed and utilized a mathematical model to assess the impacts that project-induced navigation traffic has on selected aquatic resources. A review of the Corps' document Incremental Environmental Effects of Commercial Navigation Traffic, Olmsted Locks and Dam Study, Navigation Predictive Analysis Technique (NAVPAT) (undated) revealed that the existing project conditions have substantially reduced the habitat quality of the river for fifty percent of the life stages evaluated and five of the seven species evaluated. The quality of the river's spawning habitat for sauger, paddlefish, and spotted bass has been significantly degraded by the development of the river as a navigation corridor (USFWS 1993).

Most Ohio River fishes are spawned in the mainstem, predominantly in the shore-debris zone of the river. Many of the lithophilic fish (e.g., shovelnose sturgeon, redhorses, blue sucker, and paddlefish) have declined in abundance, while fishes which produce pelagic eggs and/or larvae which float above the bottom (e.g., freshwater drum, emerald shiner and gizzard shad) have increased in relative abundance. Fishes which spawn over vegetative matter (i.e., buffalo-fishes and carpsuckers) appear to have remained stable. Nest-guarding sunfishes and basses primarily occur where protected embayments and backwaters are available for spawning. (Pearson and Krumholz 1984)

After 1900, a number of fish species apparently declined in abundance, including lampreys, shovelnose sturgeon, paddlefish, muskellunge, and blue sucker. One would also expect that the smaller, riffle-inhabiting species also were more abundant prior to 1900. Fish that were reported from the Ohio River mainstem prior to 1920, but have not been located since that time, include least brook lamprey; Alabama shad; hornyhead chub; Ozark minnow; and crystal, mud, gilt and longhead darters. By 1950, populations of a number of fish species were further reduced in abundance, including lake sturgeon, shovelnose sturgeon, bigeye chub, muskellunge, and blue sucker. And, since 1970, burbot, southern redbelly dace, dusky darter, and banded sculpin have not been reported from the mainstem Ohio River. Species which probably also declined during the period 1900-1980 include shortnose gar, mooneye, white sucker, redhorses, buffalofishes, and smallmouth and spotted basses. (Pearson and Krumholz 1984). More recent surveys conducted by the Illinois Department of Natural Resources documented that mud and dusky

darters presently occur in the Ohio River (K. Coltrell, Illinois Department of Natural Resources, pers.comm.).

Species for which there appears to be no change in abundance include emerald shiner, channel catfish and freshwater drum. Between 1900 and 1980, species which increased in abundance include: common carp, gizzard shad, threadfin shad, and perhaps, river carpsucker. Based on lock chamber rotenone sampling, the ten most abundant fishes in the Ohio River are emerald shiner, gizzard shad, freshwater drum, mimic shiner, channel catfish, common carp, bullheads, skipjack herring, white crappie, and threadfin shad. (Pearson and Krumholz 1984)

Apparently, 14 species of fish have been introduced to the Ohio River mainstem, 4 of which now have established populations in the river: carp, goldfish, white catfish and banded killifish. Of the remaining 8 species introduced, it is likely that rainbow smelt and northern pike will establish populations. In addition, there are 13 fish species that have only been reported from the river since 1970, 3 of which may have small populations only recently discovered: flathead chub, channel darter, and slenderhead darter. (Pearson and Pearson 1989)

According to Johnson (1987), 18 percent (28 species) of 159 fish species from the Ohio River are considered rare enough to be protected by law in one or more of the states bordering the Ohio River. An additional 13 percent (21 species) are considered to be of special concern by one or more of these same states because of ...low numbers, limited distributions, or recent declines. The Ohio River populations which might be particularly threatened include silver lamprey, least brook lamprey, lake sturgeon, paddlefish, alligator gar, Alabama shad, flathead chub, blue sucker, crystal darter, channel darter, and slenderhead darter (Pearson and Pearson 1989).

It is likely that the dams interfere with fish movements, which in the past eliminated the spring run of Alabama shad, and perhaps are now impairing movements of a number of other fish species (Pearson and Pearson 1989). However, some large river species (e.g., paddlefish, spotted gar, mooneye, and highfin carpsucker) have been able to reinvade upstream areas in the last 20 years as water quality improved dramatically in the upper half of the river. Populations of pollution-tolerant species (e.g., bullheads and carp) have declined in the upper third of the river over the past years, while populations of many relatively pollution-intolerant species (e.g., Hiodontids, *Moxostoma* spp. and walleye) have increased (Pearson and Krumholz 1984).

Lock chamber studies during the period 1957 through 1980 indicate that, after 1960, there were significant increases in densities of all fishes combined in the upper 100 miles of the river, and between ORM 400-600 and ORM 800-900. Species diversity indices increased significantly in the upper 100 miles of the river between 1957 and 1980. Nearly all species of fishes increased in density between 1957 and 1980, with the most dramatic increases after 1974 (Pearson and Krumholz 1984). It appears that fish communities are responding positively to the continuing improvements in water quality in the Ohio River.

The emerald shiner and mimic shiner are most abundant in the upper third of the river, while the freshwater drum is most abundant in the lower two-thirds of the river. Gizzard shad and channel catfish are evenly distributed throughout the mainstem. Generally, larval fishes are present in the

Ohio River between April and September, with densities the greatest in May and June. Larval fish density increases from the upper to the lower river. Cyprinid and percid larvae are the most abundant larva in the upper third of the Ohio River, while clupeids, cyprinids, and catostomids are most abundant in the lower two-thirds of the river. (Pearson and Krumholz 1984)

C. Ohio River Mussels

Approximately 300 species of freshwater mussels (Family Unionidae) occur within the United States. Freshwater mussels occur in permanent bodies of water ranging from large lakes to small streams. The vast majority of the species occur in streams, with the most diverse assemblages occurring in riverine shoals or gravel bars. Within the United States, the most diverse freshwater mussel fauna known occurred in the mainstems of the Tennessee River (102 species), Cumberland River (87 species), and Ohio River (72 species) (Parmalee and Bogan 1998; Johnson 1980). All three of the rivers occur within the Ohio River watershed, which historically supported approximately 127 distinct species and subspecies of freshwater mussels. Of this once rich mussel fauna, 11 mussels are extinct, 34 mussels are classified as federally endangered, and others are under review for possible addition to the Federal Endangered Species List. In less than 100 years, nearly half (44 percent) of this River basin's mussel fauna has become extinct, endangered, or been decimated to the point where Federal protection is being considered.

The French naturalist Rafinesque reported in 1820 that the Ohio River supported a unique and diverse assemblage of aquatic life, including freshwater mussels. Since that time, the Ohio River watershed's mussel fauna has been adversely affected by impoundment, siltation, channelization, and pollution. Reservoirs have flooded and destroyed many mussel populations, which is one of the primary causes of their demise in large rivers. Because the current velocity decreases as the flow approaches a dam, there is a greater amount of silt deposited in the lower pool areas. With the changes in current flow and velocity, silt has dropped out on some mussel beds in quantities great enough that the beds have been shortened or extirpated (Williams and Schuster 1989).

Within the watershed, coal-mining related siltation and acid mine drainage have adversely impacted many stream reaches with freshwater mussels. Numerous streams within the watershed have experienced mussel kills from toxic chemical spills; poor land use practices have fouled many waters with silt; and runoff from larger urban areas has degraded water and substrate quality.

Continued mussel losses can be expected because many of these same factors still threaten existing populations. Also, many of the mussel populations are now isolated and reduced to such small remnant reproductive units that they may contain insufficient genetic diversity to provide for long-term survival. In addition, some species exist only as old individuals that may no longer be capable of reproduction.

In a review of peer-reviewed published literature, unpublished reports and gray literature, Ecological Specialists, Inc. (2000) found recent reports indicating that 45 species of native

freshwater mussels are extant in the upper Ohio River (RM 0 to RM 436). An additional nine native species were reported from weathered or sub-fossil shells for a total of 54 species of freshwater mussels historically known to occur in the upper Ohio River. The following is a synopsis of Ecological Specialists, Inc.'s report (2000): Eight species that are now federally listed as endangered were reported historically from the upper river. Only two of these species are now known to be extant in the upper river. Species composition changes from upstream to downstream, with no live mussels reported from Emsworth, Dashields and Montgomery pools since 1980. Few extant species (≤ 8) are reported from New Cumberland through Hannibal pools. Willow Island pool, with 20 species, is the most upstream pool where unionids are collected consistently albeit in low density beds. Belleville pool, at 34 species, has the greatest species reported diversity of the upper river pools but this pool also had the highest sampling effort.

Finally, the diversity of Ohio River freshwater mussels is critically threatened by the recent invasion of the exotic zebra mussel into the Ohio River basin. Zebra mussels rapidly expanded their range in the Ohio River. Zebra mussels were first observed in the lower Ohio River in 1991 and had expanded upriver to Cincinnati by 1992. By 1993, low densities of zebra mussels occurred in the upper reaches of the Ohio River and only a few unionids near Cincinnati had zebra mussels on their shells. Concurrently, unionids in the lower Ohio River were covered by large numbers of adult zebra mussels. Observations in 1994 found zebra mussel densities still relatively low in the upper Ohio River, but very high in the lower Ohio River. Dunn (1995) reported that, in 1994, every unionid observed below Portsmouth, Ohio, had zebra mussels. Commercial and recreational boating activities increase the probability of unintentionally translocating exotic species such as the zebra mussel from one river reach or drainage basin to another in bilge water, on hulls, engine components, mooring lines, fishing tackle, trailers, wet suits, and other navigational components and leisure equipment.

Encrustation by zebra mussels has a severe energetic cost for native unionids (Berg et al. 1993). There is a strong relationship between the degree of zebra mussel infestation and mortality of native unionids in rivers and lakes (Schloesser 1995). Zebra mussels impair locomotion and burrowing of native unionids. They impact native unionids by preventing valve closure, preventing valves from opening, and causing food deprivation. Zebra mussel infestation in the Ohio River and its major tributaries has reached such densities that the future health of many of the freshwater mussel populations is imperiled. Effective strategies to control zebra mussel populations along the Ohio River will probably depend on complementary efforts designed to identify and reduce existing upriver source populations, and to prevent vessels from transmitting zebra mussels upstream to replenish these populations (Steingraeber 1999[draft]).

D. Ohio River Migratory Birds

Neotropical Songbirds

Songbirds that winter in South America or Latin America and breed or inhabit the Ohio River watershed during the spring and summer are in particular danger due to stress caused by fragmentation and loss of habitat in both their wintering grounds and their spring and summer

ranges. Songbird species that occur within the Ohio River watershed of particular concern to the Service include: Bewick's wren; cerulean warbler; golden winged warbler; wood thrush; Louisiana waterthrush; worm-eating warbler; Blackburnian warbler; Henslow's sparrow; eastern wood peewee; loggerhead shrike; hooded warbler; black and white warbler; dickcissel; yellow billed cuckoo; yellow-throated vireo; field sparrow, whippoorwill; Acadian flycatcher; black-billed cuckoo; black throated blue warbler; chestnut sided warbler; ovenbird; northern parula; Canada warbler; prairie warbler; gray catbird; Bachman's sparrow; summer tanager; great crested flycatcher; short-eared owl; eastern phoebe; scarlet tanager; cedar waxwing; and northern (Baltimore) oriole. Large contiguous expanses of high quality grassland and forested habitats are particularly important to these species.

Waterfowl

More than 25 species of waterfowl utilize the islands and the various other riverine habitats. The majority of the waterfowl are migratory, using the habitats as feeding and resting areas. Annual floods, primarily during the winter to spring period, create areas attractive to migratory waterfowl. Bottomland hardwoods produce mast (e.g., acorns) which are used extensively as a food source by mallards, black ducks and wood ducks when the bottoms are flooded. The more open sloughs produce emergent vegetation used by widgeon, gadwall, blue-winged and green-winged teal, and ring-necked ducks. These fertile wetlands also produce an abundant invertebrate resource that is vital as a source of protein to spring migrating ducks.

There are two principal fall migration routes for waterfowl in the basin. The eastern route cuts across northern Ohio and Pennsylvania to the Atlantic Coast. The western route enters the basin in northeastern Indiana and northwestern Ohio; follows the historic Kankakee marsh area in northern Indiana; and then proceeds down the Wabash River to wintering grounds in southern Indiana, Illinois, northwestern Kentucky, and farther south. There are minor flyways down other rivers such as the Scioto, White, and mainstem of the Ohio River.

The lower Ohio River is encompassed by the Mississippi Flyway and, as such, is an important migratory route with significant wintering populations of ducks. The lower Ohio River area is also part of the wintering area for the Mississippi Valley population (MVP) of the Canada goose. An estimated 800,000 MVP geese winter in southern Illinois, southwestern Indiana, eastern Missouri, and western Kentucky. The Southern James Bay population of the Canada goose migrates through Ohio, Pennsylvania, Indiana, and Kentucky to wintering grounds in Tennessee and Alabama. Of the last 10 years of mid-winter waterfowl survey flights, 1999 had the highest count with more than 11,300 ducks counted on the mainstem Ohio River alone from Wickliffe to Rabbit Hash, Kentucky. If one were to also include the number of waterfowl using the wildlife management areas and other areas within the Ohio River floodplain, these numbers would be significantly higher. In addition, 1999 had the highest goose count in ten years, with more than 4,100 geese along this portion of the Ohio River mainstem. The 1994 mid-winter waterfowl survey flight for the mainstem Ohio River from Newport to Ashland, Kentucky, had the highest count in ten years, with more than 1,900 ducks counted. In addition, more than 2,000 geese were counted during the 1994 flight. Once again, the numbers would be significantly greater if those utilizing the floodplain areas were included in the count.

Dabbling ducks are the most abundant and widespread group of ducks breeding in North America. This group includes black duck, mallard, wigeon, pintail, gadwall, green-winged teal, blue-winged teal, cinnamon teal, shoveler and wood duck. Continuing habitat degradation and loss since the early 1960's have diminished the likelihood of these populations recovering to former abundance without

innovative and intensive management on private and public lands, greater efforts to preserve existing habitat, and changes in land use and agricultural practices on private lands.

Shorebirds

A number of shorebird species (for example: lesser and greater yellowlegs; spotted sandpipers; semipalmated plovers; ruddy turnstone, common snipe, American woodcock, solitary sandpiper, least sandpiper, semipalmated sandpiper, killdeer) utilize the Ohio River corridor during both spring and fall migration. Important areas include mud flats and emergent wetlands.

The Ohio River mainstem falls within two of the shorebird planning regions: Upper Mississippi Valley/Great Lakes and Appalachian Mountains. The following is a synopsis of information taken from the Shorebird Conservation Plan for the Upper Mississippi Valley/Great Lake Regional Shorebird Conservation Plan (<http://www.manomet.org/USSCP/files.htm>):

"The Central Hardwoods Bird Conservation Region, which includes the lower Ohio River, is used by 20 shorebird species. Most are long-distance migrants that require suitable wetlands where they can periodically stop to replenish their fat reserves. These staging areas must have shallow water (<20 cm or 8 in deep) and/or mud flat habitats with sparse vegetation (<25 % cover), undisturbed resting areas, and abundant invertebrate food resources to meet the high energetic demands of migration (Burger et al. 1977, Cowell and Oring 1988, Hands 1988, Helmers 1991 and 1992). There are a variety of habitats that provide, or have the potential to provide, these requirements, including natural and managed wetlands, lake shorelines, river floodplains (especially along the Mississippi, Illinois, Missouri, Ohio Rivers), reservoirs, and flooded agricultural fields. Several species of shorebirds in the area forage and nest in upland habitats (e. g., grasslands, wet meadows, pastures, haylands, croplands, sparsely-vegetated beaches, and sand and gravel bars), many of which are associated with wetland complexes ."

While many natural wetlands in inland regions can potentially provide excellent shorebird habitat, precipitation directly influences wetland conditions and corresponding use by shorebirds. During dry years, naturally-receding semipermanent or permanent wetlands may provide the only unmanaged shorebird habitat available. In extremely wet years, such areas are generally flooded, sometimes with water levels well into the wet meadow zone, and these sites will not be utilized by most shorebird species. Therefore, seasonal or temporary habitats may be the only wetlands with ideal conditions in wet years. Wet and dry cycles make it difficult to predict the location, available food

resources, and duration of suitable wetland conditions of prime shorebird habitats. The dynamics of climatic cycles and the changing availability of basins cause shorebirds migrating through interior regions like the Ohio River to be scattered over larger areas and in small numbers at numerous sites, rather than concentrating at a few major staging sites, as is common along the Atlantic and Pacific coasts (Skagen and Knopf 1993, Skagen et al. 1999)."

Before the Ohio River was extensively altered, its floodplains and tributaries provided numerous sandbars, mudflats, and oxbows that were ideal habitat for shorebirds.

Colonial Waterbirds

Of the wading birds, great blue herons and green-backed herons, which nest along the Ohio River, are commonly seen feeding and roosting in the shallow water zones, fringe wetlands, and interior wetlands along the river and islands. Colonial waterbird species whose ranges encompass all or a part of the mainstem Ohio River area include:

Herring gull(M,IW)	Ring-billed gull(W,IW)
Bonaparte's gull(M)	Caspian tern(M)
Least tern(B)	Great blue heron(B,W,M)
Louisiana heron(I)	Great egret(B)
Snowy egret(I)	Cattle egret(I)
Green heron(B)	Black-crowned night heron(B,W,N)
White-faced ibis(I)	Glossy ibis(I)
Yellow-crowned night heron(B)	Double-crested cormorant(IB)
	Sabine's gull(I)
	Forster's tern(M)
	Common tern(M)
	Black tern(M)

*B=breed; W=winter; M=migrant;I=incidental

E. Ohio River Endangered Species

The federally-listed endangered (E) and threatened (T) species whose ranges include the project study area are:

Indiana bat (<i>Myotis sodalis</i>)(E)	Gray bat (<i>M. grisescens</i>)(E)
Virginia big-eared bat (<i>Plecotus townsendi virginianus</i>)	Bald eagle (<i>Haliaeetus leucocephalus</i>)(T)
Interior least tern (<i>Sterna antillarum</i>)(E)	Orangefoot pimpleback (<i>Plethobasus cooperianus</i>)(E)
Pink mucket (<i>Lampsilis abrupta</i>)(E)	Fat pocketbook (<i>Potamilus capax</i>)(E)
Fanshell (<i>Cyprogenia stegaria</i>)(E)	Clubshell (<i>Pleurobema clava</i>)(E)
White wartyback	Cracking pearlymussel (<i>Hemistena lata</i>)(E)

(<i>Plethobasus cicatricosus</i>)(E)	
Rough pigtoe (<i>Pleurobema plenum</i>)(E)	Winged mapleleaf (<i>Quadrula fragosa</i>)(E)
Northern riffleshell (<i>Epioblasma torulosa</i> <i>rangiana</i>)(E)	Catspaw (<i>Epioblasma</i> [= <i>Dysnomia</i>] <i>obliquata obliquata</i>)(E)
Dromedary pearlymussel (<i>Dromas</i> <i>dromas</i>)(E)	Tuberculed-blossom pearlymussel (<i>Epioblasma torulosa torulosa</i>)(E)
Ring pink (<i>Obovaria retusa</i>)(E)	
Virginia spiraea (<i>Spiraea</i> <i>virginiana</i>)(T)	Small whorled pogonia (<i>Isotria medeoloides</i>)(T)
Short's goldenrod (<i>Solidao shortii</i>)	Running buffalo clover (<i>Trifolium</i> <i>stoloniferum</i>)(E)

Indiana bat

The Indiana bat was listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The Endangered Species Act of 1973 extended full protection to the species.

The winter range of Indiana bats is associated with regions of well-developed limestone caverns. Major populations of this species hibernate in Kentucky, Indiana, and Missouri. Smaller winter populations have been reported from Alabama, Arkansas, Georgia, Illinois, Maryland, Mississippi, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia. More than 85 percent of the entire known population of Indiana bats hibernates in only nine caves. Currently, half of all the hibernating Indiana bats in existence (approximately 176,000) winter in Indiana.

Generally, Indiana bats hibernate from October through April (Hall 1962; LaVal and LaVal 1980), depending upon local weather conditions. Bats cluster on cave ceilings in densities ranging from 300-484 bats per square foot.

After hibernation ends in late March or early April, most Indiana bats migrate to summer roosts. Female Indiana bats emerge from hibernation in late March or early April, followed by the males. Most populations leave their hibernacula by late April. Migration is stressful for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low. As a result, adult mortality may be the highest in late March and April.

Summering Indiana bats roost in trees in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bat to roost between the bark and bole of the tree. Cavities and crevices in trees also may be used for roosting. A variety of tree species are known to be used for roosts including (but not limited to) silver maple, shagbark hickory, shellbark hickory, bitternut hickory, green ash, white ash, Eastern cottonwood, northern red oak, post oak, white oak, shingle oak, slippery elm, American elm, sassafras, and sugar maple (Romme et al. 1995). Male bats disperse throughout the range and roost individually or in small groups. In contrast, reproductive females form larger groups, referred to as maternity colonies.

Maternity colonies, which may be occupied from mid-May to mid-September, usually contain 100 or fewer adult female bats. Females each give birth to a single young in late June or early July. Maternity colonies occupy roost sites in trees in forested riparian, floodplain, or upland habitats (Romme et al. 1995). Female Indiana bats exhibit strong site fidelity to summer roosting and foraging areas. Traditional summer sites are essential to the reproductive success of local populations. If they are required to search for new roosting habitat, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from the energy demands of migration.

Indiana bat roosts are ephemeral and frequently associated with dead or dying trees. Most roost trees may be habitable for only 2-8 years (depending on the species and condition of the roost tree) under natural conditions. Gardner et al. (1991a) evaluated 39 roost trees and found that 31 percent were no longer suitable the following summer, and 33 percent of those remaining were unavailable by the second summer. A variety of suitable roosts are needed within a colony's traditional summer range for the colony to continue to exist. It is not known how many alternate roosts must be available to assure retention of a colony within a particular area, but large, nearby forest tracts appear important (Callahan 1993).

In Illinois, Gardner et al. (1991b) found that forested stream corridors, and impounded bodies of water were preferred foraging habitats for pregnant and lactating Indiana bats, which flew up to 2.4 km from upland roosts to forage. Females typically utilize larger foraging ranges than males (Garner and Gardner 1992). Bats forage at a height of approximately 2-30 meters under riparian and floodplain trees (Humphrey et al. 1977). They forage between dusk and dawn and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects. Riparian habitat is occupied by Indiana bats from mid-April to mid-September. Romme et al. (1995) cite several studies which document that Indiana bats also forage in upland forests.

After the summer maternity period, Indiana bats migrate back to traditional winter hibernacula. Some male bats may begin to arrive at hibernacula as early as July. Females typically arrive later and by September numbers of males and females are almost equal. Autumn swarming occurs prior to hibernation. During swarming, bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day. By late September many females have entered hibernation, but males may continue swarming well into October in what is believed to be an attempt to breed late arriving females.

Swarming is important to the life history of the bat as most copulation occurs during this time. Females store sperm through the winter and fertilization occurs in the spring. Females are pregnant when they arrive at the maternity roost. Fecundity is low; female Indiana bats produce only one young per year.

Gray bat

The gray bat occurs primarily in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Smaller populations, however, are known to occur in northwestern Florida, western

Georgia, southwestern Kansas, southern Indiana, southern and southwestern Illinois, northeastern Oklahoma, northeastern Mississippi, western Virginia, and western North Carolina (Barbour & Davis, 1969; Tuttle 1979). Historically, distribution was patchy, but fragmentation and isolation of populations is increasing (USFWS 1982).

Each summer colony occupies a traditional home range that often contains several roosting caves scattered along as much as 70 km of river or reservoir border (USFWS 1982). The gray bat may range up to 20km from occupied caves while out feeding at night, and nearly always feeds over streams and rivers with good wooded canopies along the bank (USFWS 1982). Foraging is generally parallel to streams, over the water at heights of 2 to 3 meters. Activities which modify the cave environment in any way, or which create large breaks in the feeding or travel corridors used by gray bats may have negative impacts. Mayflies are a major food source.

The gray bat is habitat-restricted. It occurs only in limestone caves, and only a few caves provide the appropriate temperature and humidity conditions required by the species. Maternity colonies are usually in rather large caves containing substantial streams. Evidence suggests that colonies travel from summer to winter caves and often stop at transient caves. The times of maximum migration are in April and September.

The gray bat's known summer distribution in Indiana is limited to Clark, Crawford, Floyd and Harrison Counties. The only known summer roosts are in Clark County in the watersheds of Silver Creek and a couple of small Ohio River tributaries. In Kentucky, gray bats are most common and widespread in the cave of the limestone Pennyriple region of western and west-central Kentucky. Of the Kentucky counties which border the Ohio River mainstem, there are isolated records for Breckinridge, Meade, Harden, Bullitt, Crittenden and Livingston Counties. Summer colonies are also likely to occur in these counties. Of the Illinois counties which border the Ohio River mainstem, isolated records are available for Hardin, Pope and Pulaski Counties.

Impoundment of waterways, water pollution and siltation causes loss of foraging habitat and flooding of caves. Pesticides also present a major threat.

Bald eagle

The bald eagle was federally listed as endangered in 1978 (43 FR 6233, February 14, 1978), and was downlisted to threatened status in 1995 (60 FR 36000, July 12, 1995). The downlisting was a direct result of the banning of DDT and other persistent organochloride pesticides, as well as habitat protection and other recovery efforts. The bald eagle was formally proposed for delisting on July 6, 1999 (64 FR 123; pages 3645336464).

In general, eagles nest in close proximity to lakes, rivers, or reservoirs. They construct their nests near habitat ecotones, such as lakeshores, rivers, and timber management areas (clearcuts or selective cuts). Tolerance of human activity during the nesting season has been variable, but, ideally, human disturbance of eagles should be avoided. The bald eagle's food base from the watershed includes carrion, waterfowl, and especially fish.

Bald eagles are more abundant in winter than at other times of the year along the Ohio river and in the embayments, as they shift south off frozen lakes and rivers in the north.

Interior Least Tern

The interior least tern population was estimated at 1,250 individuals in 1980. This low number coupled with the obvious continued loss and degradation of nesting islands led to the listing of the species as endangered in 1985. There is little historical information on population numbers. However, it is widely accepted that the interior least tern population was affected by loss of nesting habitat, for which there is documentation. Nesting habitat loss occurred primarily from the various channelization and irrigation projects and the construction of reservoirs and pools along many interior river systems within the population's range.

In 1987, the number of interior least terns was estimated at 4,800. More recent estimates include:

<u>Lower Mississippi</u>		<u>Missouri River</u>		<u>Ohio River</u>
1988	1995	1988	1998	presently
2,300	>6,900	549	593	400-600

Throughout the populations' range (which includes the lower Ohio River) the primary factors which limit abundance and distribution of the least tern include: 1) limited availability of suitable nesting habitat; 2) predation; and 3) human disturbance to nesting colonies.

Riverine nesting areas are sparsely vegetated sand and gravel bars within a wide, unobstructed river channel. The size of the nesting areas depend on water levels and the extent of associated sandbars. Other characteristics of valuable nesting habitat include: close proximity to shallow water areas with concentrations of forage fish; isolation of the sand/gravel bar such that access by mammalian predators is limited; and elevation of the sand bar such that inundation is precluded in most years during the nesting season while allowing for periodic flooding that scours encroaching vegetation.

Within the population's range, the construction of navigation pools and channel training structures have altered river processes that once created and distributed riverine habitats, including sand/gravel bars, throughout the river system.

In the lower Ohio River, the Corps is working with the Service and the appropriate state agencies to determine if dredged material can be used to create nesting habitat in Ohio River waters the owned by the State of Illinois.

Short's Goldenrod

This species is endemic to Kentucky where it is presently known from 5 populations located about 35 miles northeast of the city of Lexington near the junction of Robertson, Nicholas, and Fleming Counties. One population is found within Blue Licks Battlefield State Park, Robertson

County; another population is just outside the Park's boundary, 0.1 mile into Nicholas County. The other three populations - one each in Nicholas, Fleming, and Robertson Counties - are within a 2-mile radius of the Park. Populations outside of the Park are on private property. The species was scientifically described in 1842 from collections apparently made at Rock Island, adjacent to Falls of the Ohio in Jefferson County. This site was later inundated by dam construction. In 1939, numerous populations were reportedly growing on rocky slopes and in pastures in Nicholas and Fleming Counties, but today only three are known. The population in the Blue Licks Battlefield State Park numbers about 2,000, is found primarily within a 1.5-acre area, and represents about 50 to 60 percent of all the existing plants. The majority of the remaining plants are found in the other population also located in Robertson County.

Short's goldenrod grows in cedar glades and openings in oak and hickory forests, in areas adjacent to the Old Buffalo Trace, and in pastures and areas adjacent to roads. Some type of natural disturbance seems to be important. Bison-caused disturbances were perhaps important in the past,

and it is suggested that bison may have been a dispersal vector. Fire may have been a factor in the past by forming woodland openings in which the species could grow.

The species' highly restricted distribution and limited numbers increase its vulnerability and make any losses potentially more serious. One known habitat loss occurred in the middle 1970's when a major segment of the Blue Licks Battlefield State Park population was lost during the construction of a new campground. Current threats include: inadvertent trampling and destruction; habitat modification or loss where the land is privately-owned; overcollecting for scientific purposes on these same lands; and the possibility of destructive fires. Although fire may have been important historically in maintaining suitable habitat, fire in the current remnant habitat could destroy whole populations.

Most of the plants in the State Park populations are within a 1.5-acre area which has been dedicated by the Kentucky Nature Preserves Commission as a nature preserve. Research is needed to determine proper management techniques for maintenance of the species on this site, as well as on the four privately-owned sites. The latter sites should also be protected by the most feasible means. To provide greater security, consideration should be given to establishing additional populations within the historic range.

In 1995, an attempt was made by the States of Indiana and Kentucky, in cooperation with the Corps, the Service and the Shooting Star Nursery, to restore Short's goldenrod to the Falls of the Ohio. Seven clumps of Short's goldenrod were planted in historic habitat on the Indiana side of the Falls. This initial effort was unsuccessful due to extended inundation from high water in the spring of 1996. It is expected that further attempts will be made to restore Short's goldenrod to this historic location.

Small whorled pogonia

The small whorled pogonia is widely distributed with a primary range extending from southern Maine and New Hampshire through the Atlantic seaboard States to northern Georgia and southeastern Tennessee. Outlying colonies have been found in the western half of Pennsylvania, Ohio, Michigan, Illinois, and Ontario, Canada.

There are three main population centers of *Isotria medeoloides*. The northernmost concentration, comprising 66 sites in 1993, is centered in the foothills of the Appalachian Mountains in New England and northern coastal Massachusetts, with one outlying site in Rhode Island. A second grouping of 18 sites is located at the southern extreme of the Appalachian chain in the Blue Ridge Mountains where North Carolina, South Carolina, Georgia, and Tennessee join. The third center, with 13 sites, is concentrated in the coastal plain and piedmont provinces of Virginia, with outliers in Delaware and New Jersey. Seven sites scattered in the outlying States and Ontario are considered disjunct populations.

This herbaceous perennial orchid species occurs both in fairly young forests and in maturing stands of mixed-deciduous or mixed-deciduous/coniferous forests. The majority of small whorled pogonia sites share several common characteristics. These may include sparse to moderate ground cover in the microhabitat (except when among ferns), a relatively open understory canopy, and proximity to old logging roads, streams, or other features that create long-persisting breaks in the forest canopy (Mehrhoff 1989). The soil in which the shallow-rooted small whorled pogonia grows is usually covered with leaf litter and decaying material (Mehrhoff 1980, Sperduto 1993). The spectrum of habitats includes dry, rocky, wooded slopes to moist slopes or slope bases crisscrossed by vernal streams. It has been found near logging roads, streams and open canopy areas. Within the Ohio River corridor area, the species occurs in Scioto County, Ohio.

Running buffalo clover

Running buffalo clover was listed as a federally endangered species in 1987 (50 FR 21478-21480). Historically the species occurred in Arkansas, Illinois, Indiana, Kentucky, Missouri, Nebraska, Ohio, and West Virginia. Until the rediscovery of two small populations of the species in West Virginia in 1985, running buffalo clover was believed to be extinct. The currently known distribution is:

Arkansas - 0 populations	Illinois - 0 populations
Indiana - 2 populations	Kentucky - 23 populations
Missouri - 1? population	Nebraska - 0 populations
Ohio - 12 populations	West Virginia - 8 populations

These sites vary in size from a few individuals covering a few square feet to hundreds of individuals over a quarter of an acre.

The original habitat for the species is believed to have been areas of rich soils in the ecotone between open forest and prairie. These areas are believed to have been maintained by the disturbance caused by the buffalo. Most of the recently discovered populations are in areas

receiving at least some disturbance such as that caused by grazing and mowing.

The causes for the long-term decline of running buffalo clover are not definitely known. However, they are believed to be directly related to the disappearance of large herbivores from the plant's habitat. Additionally, declines of some current populations have been associated with disturbance by 4-wheel drive vehicles. This species appears to have been dependent upon the woodland disturbance created by large animals, especially the buffalo. Many of the species' old records were in close proximity to buffalo licks and trails. Present threats to the running buffalo clover include trampling.

The recovery plan's criteria for downlisting the plant to threatened status includes the discovery or establishment of 30 secure, self-sustaining populations (Bartgis 1989). Although more than 30 populations are now known, few can be considered secure and self sustaining.

In Indiana, the current range of running buffalo clover includes Dearborn, Jennings, Ohio, Ripley and Switzerland Counties. With the exception of Jennings County, all of these current county records are within the project area. The known populations in the project area are found in valleys of small Ohio River tributaries, in association with cattle grazing. All similar habitats within the aforementioned counties should be considered potential habitat for running buffalo clover.

Endangered Freshwater Mussels

Historically, there were 72 species of freshwater mussel reported from the mainstem of the Ohio River (Johnson 1980). Federally-listed freshwater mussel species considered to be extirpated from the Ohio River include white wartyback, cracking pearlymussel, rough pigtoe, winged mapleleaf, northern riffleshell, and catspaw. The ring pink may be present but has not been reported from the mainstem Ohio River for a considerable amount of time. The tuberculed-blossom pearlymussel once occurred in the Ohio River but may be extinct. Finally, historical records indicate that the dromedary pearlymussel may have occurred in the mainstem Ohio River, but definitive data is not available.

Orangefoot pimpleback - The orangefoot pimpleback (*Plethobasus cooperianus*) prefers clean, fast-flowing water in silt-free rubble, gravel or sand of medium to large rivers. It buries itself in sand or gravel in water as deep as 29 feet. Only the edge of its shell and its feeding siphons are exposed. Reproduction requires a stable, undisturbed habitat and a sufficient population of fish hosts to complete the mussel's larval development.

Dams and reservoirs have flooded most of this mussel's habitat, reducing its gravel and sand habitat and probably affecting the distribution of its fish hosts. Reservoirs are fatal to most riverine mussels; one researcher counted 45 mussel species in a river before the construction of a dam. Four months after the dam was completed, he could find none. Dams and reservoirs are barriers that isolate upstream populations from downstream ones. Other threats include pollution from agricultural and industrial runoff, and siltation following deforestation. These chemicals

and toxic metals become concentrated in the body tissues of such filter-feeding mussels as the orangefoot pimpleback, eventually poisoning it to death.

The present range of the orangefoot pimpleback includes only the Tennessee River in Hardin County, Tennessee; Cumberland River in Smith County, Tennessee; and lower Ohio River in Ballard and McCracken Counties, Kentucky (USFWS 1984). The species is known to be reproducing in the Tennessee River and is likely reproducing in the Ohio River. However, because of cold water releases from Center Hill Dam and Cordell Hull Dam, the population in the Cumberland River consists of old, non-reproducing individuals.

Fat pocketbook - There are numerous recent records for the species in the Ohio River from the Wabash River and downstream. The fat pocketbook is a large river species which prefers substrates of mixed sand, silt and clay. Its decline is believed to be related to extensive dredging and other activities which destabilize substrates. The fat pocketbook's range in Indiana is limited to the lower Wabash River in Gibson, Knox and Posey Counties. In the lower Wabash it is often associated with islands and typically not associated with large mussel beds. Within the J.T. Myers project area, there are current records around the mouth of the Wabash River near Wabash Island in the Ohio River mainstem.

Clubshell mussel - Historically, the species ranged widely and was abundant in the States of Alabama, Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, Tennessee, and West Virginia (USFWS 1994b). It existed in the Ohio River basin in the Ohio, Allegheny, Scioto, Kanawha, Little Kanawha, Licking, Kentucky, Wabash, White, Vermillion, Mississinewa, Tippecanoe, Tennessee, Green, and Salt Rivers. It was found in the Maumee River basin and tributaries of western Lake Erie (Huron River and River Raisin).

The clubshell currently is known to occur in 12 streams. The only recent report for the clubshell from the mainstem Ohio River is a report of a (presumably live) clubshell from the Haunted Hollow mussel bed in Harrison County, Indiana during Clark's 1993/94 Ohio River survey (1995). The current distribution represents a range reduction greater than 95 percent (USFWS 1994).

This freshwater mussel occurs in small rivers and streams in clean sweep sand and gravel. The reduction in the clubshell's range can be attributed to many factors. However, the primary factors include impoundments, channelization, loss of riparian habitat, and the impacts of silt from poor land uses. Water pollution from municipalities, chemical discharges, coal mines, and reservoir releases also have impacted the species. As discussed earlier, the invasion of the exotic mussel poses another threat to this species.

Pink mucket - The pink mucket is an Ohioan or Interior Basin species found in medium to large rivers, associated with moderate to fast-flowing water and depths ranging from 0.5 to 8.0 meters (USFWS 1985b). Its habitats range from silt to boulders, rubble, gravel, and sand substrates (Hickman, 1937; Yokley, 1972; Buchanan, 1980; Clarke, 1982.)

Historically, the species was widespread in distribution, occurring in at least 25 rivers (USFWS 1985b). It has always been considered as uncommon or rare. Although the specific reasons for the decline of this species are unknown, it is believed they are similar to the reasons most our native freshwater mollusks are in decline (see section VI.A.2. above): impoundment; siltation; and pollution.

The pink mucket is presently known from 16 different rivers representing 3 major geographic regions, one of which is the Tennessee/Cumberland/Ohio River System (USFWS 1985b). It has been collected in Greenup Pool.

Fanshell - The fanshell inhabits gravel substrate in medium to large rivers of the Ohio River basin. The species' distribution and reproductive capacity has been seriously impacted by the construction and operation of reservoirs and by other impacts on water and substrate quality. Unless new populations are found or created and existing populations are maintained, this species will likely become extinct in the foreseeable future (USFWS 1991b). The fanshell is known to occur in the Belleville and Racine pools of the Ohio River. Biologists discovered a new site for the fanshell in the backchannel of Muskingum Island when they examined shells from a muskrat midden on the Ohio River Islands National Wildlife Refuge. The freshly dead mussels were 9 and 11 years of age. This further supports a theory that the upper Ohio River is an important recovery area for this species.

Historically, the species was widely distributed in the Ohio, Wabash, Cumberland, and Tennessee Rivers and their larger tributaries in Pennsylvania, Ohio, West Virginia, Illinois, Indiana, Kentucky, Tennessee, Alabama, and Virginia. There are only three known reproducing populations remaining: Green River, Kentucky; Clinch River, Virginia and Tennessee; and Licking River, Kentucky. Small remnant populations may still be present in the Muskingum River, Ohio; the Walhonding River, Ohio; the East Fork White River, Indiana, the Tippecanoe River, Indiana, the Kanawha River, West Virginia, Tygarts Creek, Kentucky; Barren River, Kentucky, Cumberland River, Tennessee and Tennessee River, Tennessee.

E. Ohio River Habitats of Concern

Within the Ohio River mainstem area, there are a variety of habitats important to Ohio River fish and wildlife. These areas include, but are not limited to: islands and backchannel areas; gravel/sand bars, cobble substrates, and tailwaters; bottomland forest, riparian corridor, and wetlands; embayments; uplands and unique habitats; tributary rivers and streams; and National Wildlife Refuges.

Islands And Backchannel Areas

Since the locks and dams were constructed on the river, the dynamic forces that were responsible for creating the islands within the mainstem Ohio River are no longer prevalent. Many of the islands that previously existed are no longer present due to the impacts of dredging, inundation, sedimentation, and erosion. At the turn of the 19th century, there were 124 islands in the Ohio

River mainstem, comprising approximately 25,291 acres. Since the 1911-1914 benchmark, 31 islands have been lost completely, and 10,906.4 acres (net loss) of terrestrial habitat have disappeared. Presently, there are 93 islands comprising 14,384.6 total acres of terrestrial habitat (Patricia Morrison, Ohio River Islands National Wildlife Refuge, pers. comm. dated 1/11/00). Of the 31 islands lost completely, 20 were lost from the upper 300 miles of the Ohio River mainstem.

For a number of the Ohio River islands, the habitats contain near natural assemblages of plants and animals native to the river, particularly when compared to the past and present use and development of the Ohio River and its floodplain. The often complex interspersed bottomland and riparian habitats and deep and shallow aquatic habitats make these areas extremely valuable to numerous fish and wildlife species. The deep and shallow water habitats associated with the islands are major fish and mussel production areas in the Ohio River. The often undisturbed island shorelines, especially the heads and back channels, are favored sport fishing areas. Back channels offer unique spawning and nursery habitat for a number of fish species and typically offer feeding areas for adult fish. The diversity of water depths, current patterns, substrates and riparian cover provided by the islands provide habitats for large numbers of fish, macro-invertebrates, waterfowl, shore and wading birds, and riparian furbearers.

The substrates associated with islands are largely a function of current velocity and pattern. Sand, gravel and cobble are predominant at island heads and in some back channels exposed to the thalweg or which naturally receive a great volume of river flow. With the exception of the dam tailwaters, the heads of the islands most closely resemble a natural run/riffle habitat. Kritsky () conducted a survey for three species of riparian tiger beetles, *Cincincela hirticollis*, *C. cuprascens*, and *C. marginipennis*, along approximately 300 miles of beaches along the Ohio River and its tributaries from east Ohio west to eastern Indiana. These three species are sensitive to habitat destruction and have declined or been extirpated in a number of areas. Kritsky et al.'s review of the 1814 publication of the Navigator, a publication of river descriptions for boat pilots on the Ohio River, indicated that the Ohio River would run dry during the summer months in the early nineteenth century. Based on the 1814 information, sandy beaches, sandbars, and willow islands had been common in the survey area along the Ohio River. These types of habitats are ideal habitats for *C. hirticollis* and *C. cuprascens*. Other areas were apparently more rocky which is the preferred habitat for *C. marginipennis*.

After impoundment of the river through the series of navigation locks and dams, the sandy shores and bars present in 1814 were replaced with high banks. In the survey area, Kritsky et al. found that the banks from five to ten miles upstream of a lock and dam are devoid of sandy beaches, with a few pockets of suitable sandy beaches immediately downstream of a lock and dam. These pockets of sandy beaches had dense tiger beetle populations, except for *C. hirticollis*, which the authors consider extirpated from the mainstem Ohio River. *C. hirticollis* was once a common tiger beetle on the sandy beaches of rivers and large lakes in the eastern United States, but has declined throughout its range.

Gravel/Sand Bars, Cobble Substrates And Tailwaters

Diversity in the topography of the river bottom is important in maintaining a diversity of plant and animal life. In shallow areas with swift waters, gravel beds and riffles provide habitat and spawning areas for many species. Where currents are slower, submerged and emergent vegetation become established. This vegetation provides food and shelter for a different group of aquatic species. All sediment sizes have some habitat value for select species. For example, burrowing invertebrates prefer sandy bottoms and many filter-feeding insects require a stable, hard substrate surface. However, the highest productivity and diversity of benthic organisms occurs in riffle habitats of medium cobble and gravel. Fine sediments or areas of continually shifting sands tend to reduce macro-invertebrate species abundance and diversity, which may then affect fish species abundance and diversity.

It is likely that the most important effect of human environmental disturbance on Ohio River fishes is the siltation and inundation of much of the original clean gravel or rubble substrate of the river bed (Pearson and Pearson 1989). With exception of the tailwaters, the heads of the islands most closely resemble a natural run/riffle habitat in the Ohio River. This coarse substrate provides lithophilic species of fish, which were the predominant type of fish in the historic Ohio River, with their preferred spawning substrate, which is now in short supply. When sediment deposition exceeds sediment transport, deposits of fine sediment can cover gravel bottoms that many organisms require for feeding and reproduction. When these areas are smothered by fine sediments, habitat quality is reduced and may result in the smothering of fish eggs and larvae.

Freshwater mussels are found in a variety of habitats ranging from mud and sand between bedrock ledges and boulders to rubble and gravel substrates. The majority of freshwater mussel species are typically found in riverine conditions in relatively firm rubble, gravel and sand substrates swept free from siltation by currents. These mussels are usually found buried in the substrate in shallow riffles and shoal areas. Siltation of these areas has severely affected freshwater mussels. Specific impacts to mussels from sediment include clogged gills, which reduces feeding and respiratory efficiencies, disrupts metabolic processes, and reduces growth rates; contributes to substrata instability; and can physically smother mussels under a blanket of silt (Ellis 1936, Stansbery 1971, Marking and Bills 1979, Kat 1982, Aldridge et al. 1987). Since most freshwater mussels are typically riverine species that require clean, flowing water over stable, silt-free rubble, gravel and sand shoals, the smothering action by siltation is often severe.

Bottomland Forest, Riparian Corridor, And Wetlands

Downstream from Louisville, Kentucky (RM 606), the Ohio River is a "floodplain river." Upstream from Louisville, the river channel becomes constricted with small floodplains common with portions of the river (Thorp 1992). The Ohio River Basin Comprehensive Survey (USACE 1967) indicates that the area adjacent to the Ohio River mainstem flooded during the floods of record encompassed 1, 840,803 acres. This figure is based upon the Flood of Record for the lower reach(1937), for the middle reach (1937 or 1913), and for the upper reach (1936). More

than 20 years ago, a 1977 air photo analysis indicated that the Ohio River floodplain encompassed 846,700 acres (Ohio River Basin Commission 1978a).

Floodplains offer a number of different habitats and zones. These include constantly inundated channels and lakes, overflow riverine wetlands and dry uplands which are infrequently inundated. Floods are the recurring feature of floodplains. Fish populations are dependent upon the overflow areas for food production, feeding, spawning and rearing of young (Lambou 1989). Floodplains can support extensive fish populations, depending upon water regimes, size of the river system, proximity to estuarine and marine waters, physical and chemical characteristics of the water and geographic location of the river basin.

The types of plants and animals found in oxbow marshes and backwater lakes are determined largely by the periodic flooding of these areas by the main river. Because this annual flood is a predictable and recurring phenomenon, many organisms have evolved adaptations that enable them to exploit the seasonally expanded habitat and the food brought in by the flood. Times of low water, however, are just as important as flooding. A low water level concentrates fish into shallow pools where herons and egrets obtain food for nestlings; it exposes mudflats where moist-soil plants grow and produce seeds sought by waterfowl; and it allows soils to drain and be exposed to oxygen, thereby speeding the processes of decay and the recycling of nutrients.

In the Ohio River floodplain, a typical habitat structure was a matrix of bottomland forest interspersed with components of other wetland types such as sloughs and oxbows. Much of this habitat has been drained and cleared for agriculture, leaving the remainder highly fragmented; however, several high-quality natural areas remain. In the last few decades, some of the more wet agricultural areas have become too difficult to maintain due to increased costs of drainage and to environmental laws such as the Clean Water Act, and these have reverted to substantial wetland complexes.

A quick analysis was conducted to estimate the amount of forested riparian habitat remaining along the Ohio River mainstem. For this analysis, it was assumed that, during the benchmark timeframe of 1800, the entire river corridor was forested, i.e., a forested riparian corridor encompassed 1,962 linear miles on both banks of the river. Using aerial photography for randomly selected 20-mile stretches of river in each of the three Corps Districts (Louisville/Pittsburgh photos date 1995; Huntington photos dated 1984), the length of remaining intact forested riparian habitat along each of the two banks was calculated. Intact forested riparian habitat was defined as having stable, undeveloped banks that support mature native riparian vegetation of sufficient width to provide some wildlife habitat value (forage/cover) and/or provide buffer for the river habitats from mainland development. The percent forested riparian habitat for each evaluated reach was calculated, and then this number was applied to the total number of riparian miles for each Corps' District (Barbara Douglas, USFWS, pers.comm., 2000) (Table 1).

District	Total Miles	% Riparian Habitat Remaining	Miles Riparian Habitat Lost
Pittsburgh	254.4	29	180.6
Huntington	621.6	34	410.2
Louisville	1086	62.4	408.3
TOTAL	1962	-----	999.1

Table 1. Estimation of forest riparian habitat on the banks of the Ohio River mainstem. (B. Douglas, USFWS, pers. comm. 2000)

The Ohio River Basin Commission's (1978a) air photo wetland/embayment inventory indicated that, within the 846,700-acre Ohio River floodplain, remaining wetlands associated with embayments totaled 13,500 acres and "isolated" wetlands totaled 19,500 acres or 2.3% of the floodplain. The 435-mile-long Lower Ohio Mainstem includes the Ohio River from the mouth of the Kentucky River to the confluence of the Ohio and Mississippi Rivers (ORBC 1978b). This area includes parts of the states of Kentucky, Indiana and Illinois. The Commission's air photo wetland/embayment inventory indicates that wetlands along the Ohio River in the Lower Ohio Main Stem total about 18,000 acres, or about 3% of the 602,100-acre floodplain. An addition 6,000 acres of wetlands are associated with embayments. Much of the remaining 584,000 acres of floodplain was previously wetland which has been cleared of timber and drained or filled for agriculture and other uses (ORBC 1978b).

The Middle Ohio Mainstem includes the Ohio River from the confluence of the Kanawha River (RM 266) to the confluence of the Kentucky River (RM 546). This 280-mile-long area includes parts of the states of West Virginia, Ohio, Indiana and Kentucky and the cities of Cincinnati and Huntington (Ohio River Basin Commission 1978c). The 1977 air photo analysis indicated that approximately 5,200 acres of wetlands/embayments remained in the 144,700-acre floodplain of the Middle Ohio Mainstem. Approximately 640 acres of the 5,200 acres of wetlands are "isolated," not connected with embayments or directly with the river. Much of the remaining 144,700 acres of flood plain was previously wetland which has been cleared of timber and drained or filled for agriculture and other uses (ORBC 1978c).

The Upper Ohio Mainstem consists of the Ohio River from the confluence of the Allegheny River and Monongahela River at Pittsburgh to its confluence with the Kanawha River at RM 266. The commission's wetland/embayment inventory indicates that 860 acres of wetlands remained in the 9,900-acre Upper Ohio River floodplain. Embayment-related wetlands account for 940 acres (ORBC 1978a).

Wetlands formed by rivers are of several types, including oxbow marshes, floodplain bottomlands, and backwater lakes. When a meandering river changes course and leaves a portion of its channel isolated except during flood, an oxbow pond is formed. In time, this pond fills in and becomes an oxbow marsh..

Backwater (bottomland) lakes form when soil and sand settle out of river currents and form long islands in the river. If such an island becomes high enough to completely separate the side channel from the main river, a bottomland lake is formed. In addition, human activities create as well as destroy wetlands, and some wetlands are produced by impoundments, excavations, and the construction of dikes.

Emergent wetlands are dominated by erect, rooted, herbaceous hydrophytic vegetation (e.g., sedges, grasses, and numerous species of forbes). Vegetation may remain visible throughout the year or die back in the nongrowing season. Emergent wetlands are classified into two categories: shallow marsh/wet meadow (where standing water or soil saturation is present for brief to moderate periods during the growing season) and deep marsh (where standing water is present, or the soil is saturated, on a semipermanent to permanent basis during the growing season). Examples include sedge meadows dominated by tussock sedge, wet prairie dominated by cord grass, and marshes. Water depth in marshes ranges from zero (saturated soil) to 6.6 feet (2 m). In Midwestern marshes, both floating-leaf plants (e.g., water lily) and submerged aquatic plants (e.g., pondweed) are frequently associated with cattails, an emergent species. The soils that underlie marshes are sometimes mineral, but are often covered by muck (organic sediment).

Marshes are highly productive habitats in which hundreds of species of birds, insects, and other wildlife spend most of their lives. Two factors account for the high productivity of marshes. One is the ability of marsh plants to capture large amounts of energy from the sun and transform and store much of it as chemical energy in the form of plant tissue. The other is the efficient recycling of nutrients already produced.

Forested wetlands are dominated by woody vegetation. They are differentiated into swamps or bottomland forest based on the duration of the presence of water. Swamps are forested areas in which the woody vegetation is 20 feet (6 m) or more in height and water is present on a permanent or semipermanent basis; the woody vegetation is adapted to prolonged exposure to standing water. Forested swamps, once common in the southern Midwest, are often dominated by bald cypress and water tupelo. The soil in forested swamps may be either organic or mineral, but usually has a topmost organic layer underlain with a mineral soil. Shrub swamps are similar to forested swamps except that less of the vegetation is in the form of trees. Typical plants include willows, buttonbush, swamp rose, and a few species of dogwood growing in mostly mineral soils.

Bottomland or floodplain forests are temporarily or seasonally flooded areas that usually occur along streams and rivers. Because these forests are flooded frequently, they have a lower diversity of tree species than forests located on higher ground. The understory is typically open, and the ground cover is sometimes dominated by nettles. Rotting logs and woody debris deposited by floodwaters are abundant. Typical trees of Midwestern floodplain forests are silver

maple, cottonwood, green ash, hackberry, and sycamore. Several oak species can be found on terraces bordering floodplains. The soils that support these forests are usually mineral.

Bottomland forest overlaps broadly with wetlands. Some bottomland forest on alluvial soils is relatively well-drained, and forest on floodplain terraces may be flooded only irregularly; however, all bottomland forest types are of high value for wildlife. In most cases, historical wetland complexes along the Ohio River existed within a matrix of bottomland forest. Several plant species native to southwestern Indiana are at the northern limits of their range, and therefore are classified as endangered, threatened or rare species by the State of Indiana.

Significant wildlife use of wetlands and bottomland forest habitats include the Indiana bat (federally endangered), bald eagle (federally threatened), copperbelly watersnake (federally threatened in the northern part of its range), several state-endangered species, furbearers, waterfowl, colonial wading birds, neotropical migrant songbirds, and a variety of reptiles and amphibians.

Embayments

Prior to impoundment, the Ohio River was a relatively shallow river with numerous islands, gravel bars, channel wetlands (riverine emergent, and riverine aquatic bed), and adjacent overflow sloughs surrounded by bottomland hardwood forests. Impoundment of the river for navigation interests created primarily deepwater habitat along the main channel corridor (average depth in channel 20-30 feet), with many islands, shallow bars, and channel wetlands consequently disappearing. Most of the remaining shallow water and wetlands in the floodplain occur in the embayments - the drowned tributary mouths inundated by backwaters from the impounded Ohio River.

Major wetland habitat types and dominant plant species (if any) in the embayments include:

5. **riverine open water** - deep water, mudflats, and exposed cobble/gravel;
6. **riverine emergent** - water willow, American lotus, lizardtail, bullhead lily, arrowhead, horsetail, arrow arum, yellow iris
7. **riverine aquatic bed** - water celery, pondweeds, milfoils, duckweed, Elodea sp., coontail, naiads
8. **palustrine open water** - deep water and mudflats, cut-off from flow
9. **palustrine emergent** - smartweeds, wild millet, cattail, sedges, rushes, sweet flag, bulrushes, wild rye, rice cutgrass, false nettle, spike rushes, swamp milkweed, sensitive fern, swamp rose mallow, burreed, marsh purslane, monkeyflowers, vervains, spotted and pale touch-me-nots, boneset, cardinal flower, beggar-ticks, loosestrife, seedbox, bedstraw, bugleweed, water

horehound, tickseed sunflowers, black elderberry, St. Johnswort, moneywort, ditch stonecrop, primrose willow, and dodder

10. **palustrine scrub/shrub** - black willow, brookside alder, buttonbush, dogwoods, false indigo, sandbar willow, swamp rose

11. **palustrine forested** - black willow, eastern cottonwood, sycamore, slippery elm, silver maple, American elm, river birch, green ash, pin oak, hackberry

In summer, during the height of the growing season, the diversity of wetland plants and habitat types provide excellent food and cover for migratory and resident wildlife. The shallow water habitats are important feeding areas for wading birds such as great blue herons, great egrets and black-crowned night herons, especially for those which nest in heronries nearby and feed in the embayments while raising their young. After fledging, juvenile herons concentrate in the embayments as well. Wood ducks, mallards, and Canada geese nest and raise their broods in the embayments and along the mainland wetlands in summer.

Young-of-year fishes find shelter in the riverine aquatic bed and emergent wetlands. The embayments are important nursery areas for Ohio River fishes, particularly Centrarchids. The embayments also support an abundance of amphibians and reptiles (i.e., snapping turtles, spiny-softshell turtles, painted turtles, map turtles, northern water snake, bull frog, leopard frog, green frog, pickerel frog, grey tree frog, spring peeper, fowler's toad, American toad), as well as at least 19 species of mussels.

Fall generally brings lower water levels in the embayments, exposing mudflats and invertebrates as well as aquatic plants to feed migrating shorebirds, wading birds and waterfowl. Native wildlife food plants such as smartweeds, bulrushes, wild rye and millet lie down and become available to migratory birds and other wildlife. Soft mast-producing trees and shrubs dominate in the embayments (elderberry, cherry, spicebush, hackberry, grape, dogwoods), providing abundant food for migratory landbirds en-route to their southern destinations.

During winter, the emergent wetland vegetation in the embayments lays down and dies back, but submerged aquatic vegetation and rootstocks remain as important food for wintering waterfowl and muskrat. While high water and swift currents are common on the main river in winter, the embayments provide quiet resting places off the main river for fish and wildlife. Over 25 species of waterfowl (ducks, geese, swans, mergansers) and other waterbirds (loons, grebes, and gulls) rest and feed in the embayments in winter as long as they remain ice-free spring comes to the embayments earlier than the main river, as the shallow waters warm up faster. Those bottomlands which were flooded in winter "green up," and exposed mudflats again nourish migrating shorebirds and wading birds. Herons and waterfowl begin to nest as early as March. Neotropical migratory landbirds also return to nest, including warblers, thrushes, vireos, cuckoos, flycatchers, and tanagers. Many more species pass through on their journey back to their northern breeding range, stopping and feeding on late fruits, early seeds, and abundant insects.

Uplands And Unique Habitats

Historically, the Ohio River floodplain was primarily forested habitat, with scattered prairies, canebreaks and wetlands in the floodplains of the main river and its tributaries. Scattered remnant unique habitats such as dry forest glades, post oak flatwoods and clay barrens may still be found. Bluffs border some areas of the Ohio River shoreline, which provide habitat for a number of species of concern. For example, an area of limestone terraced/vase river bluffs in Crawford County, Indiana supports the second best woodrat population in that state. Most of this area has been settled, cleared, drained, farmed and developed, resulting in the outright loss of habitat, and the fragmentation of that which remains. Significant wildlife use by upland forests in the study area includes the endangered Indiana bat and gray bat, raptors (including nesting bald eagles) and neotropical migrant songbirds.

Tributary Rivers And Streams

The U.S. Fish and Wildlife Service's Ohio River Valley Ecosystem Team selected the mainstem Ohio River and a number of its tributaries as focus areas for the biological significance of their fish resources. Selected tributaries include: Kentucky River, KY; Wabash River, IL & IN; Green River, KY; Scioto River, OH; Muskingum River, OH; Licking River, KY; Blue River, IN; Kinniconnick River, KY; and Tygart River, WV. In addition, the mainstem Ohio River and the following tributaries to the Ohio River were selected as focus areas for the biological significance of their mussel resources: Middle Island Creek, WV; Green River, KY; Wabash River, IN/IL; Licking River, KY; Allegheny River, PA; and Upper Kanawha River, WV. Some tributaries, such as the Wabash River, contain diverse faunal communities with many rare species, while others have been degraded by dredging and sedimentation. The Wabash River has the largest and most diverse fauna in Indiana. Over 100 fish species have recently been identified from the Wabash River. The lower Wabash contains a major compliment of big river fishes, and because the river is free-flowing it contains healthier populations of some species (e.g. blue sucker) than the Ohio River.

In 1992, an assessment of Kentucky Rivers was completed to identify resource values and opportunities for management of Kentucky's rivers (Kentucky Division of Water and National Park Service 1992). River systems were evaluated for ten resource categories: agricultural lands, botanical resources, corridor character, cultural resources, fish resources, geologic and scenic features, recreational boating, water quality, water resources, and wildlife resources. Of the 551 rivers selected for evaluation, 25 were determined to have 7 or more significant resources values. Of these 25 rivers, the following Ohio River tributaries had high scores for botanical, fish and wildlife resources, and water quality: Barren River; Cumberland River; Green River; Kentucky River; Little Sandy River; Tygarts Creek; and, Licking River.

F. U.S. Fish and Wildlife Service - National Wildlife Refuge Lands

Ohio River Islands National Wildlife Refuge was established on November 13, 1990. The islands lie within a 362-mile stretch of the Ohio River from Shippingsport, Pennsylvania to Manchester, Ohio and range in size from less than 1 acre to nearly 500 acres. The refuge now includes 20 of the 38 islands within the refuge acquisition boundary. Of the 38 islands, 33 are located in West Virginia, with the remaining islands situated in Pennsylvania and Kentucky. The islands consist primarily of 2,200 acres of bottomland hardwood forest (a remnant of the Ohio River floodplain forest of the early 1800's), reverting fields, and agricultural land. Nearly all of the islands have relatively undisturbed backchannel areas totaling 1,510 acres.

The interspersed habitats of the Ohio River islands support a diverse assemblage of plants and animals native to the river and its floodplain. The refuge includes significant acreage of underwater habitat which supports important interjurisdictional fish (such as paddlefish and shovelnose sturgeon), 55 species of other warmwater fish, and all of the 45 freshwater mussel species reported to be extant in the upper river (RM 0 to RM 436). Two federally listed endangered mussels (pink mucket and fanshell) are confirmed within the refuge boundary, along with the threatened bald eagle. It is likely that the endangered Indiana bat also occurs within the refuge boundary. A total of 188 bird species (76 of which breed there), 45 mollusk species, 15 species of reptiles and amphibians, and 25 mammals have been identified within the ORINWR.

Wetland/Embayment Expansion Package - In September 1995, the Service granted approval for a wetland/embayment expansion addition to the refuge of 5,400 acres of undisturbed bottomlands along the Ohio River floodplain. This included a total of 100 individual areas along the Ohio River corridor spread throughout Pennsylvania, West Virginia, Ohio and Kentucky, ranging in size from 4 acres to 170 acres. These lands extend from RM 31 to RM 436. Approximately 56 percent of the total area, or 3,036 acres, is comprised of shallow water wetlands (riverine and palustrine open water, aquatic bed, emergent, scrub-shrub, and forested) and the remaining 2,348 acres is principally mature and immature bottomland hardwood forest and some low-lying agricultural lands. Many of the parcels are adjacent to current refuge islands and predominately located within the river floodplain boundaries.

The proposed additions represent the most valuable remaining, undeveloped bottomland hardwood forest, emergent wetlands and shallow water habitats along the floodplain of the upper Ohio River. During the one year of reconnaissance level field work, over 130 species of migratory birds were encountered, including 36 species of waterbirds, 10 species of raptors, and 86 neotropical and other migratory landbirds, including 14 nongame species of management concern in the Northeast.

VIII. EVALUATION OF THE SELECTED PLAN

With the Ohio River Ecosystem Restoration Project Partnership, additional habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources. However, without careful evaluation of proposed site-specific projects for potential undesirable secondary or indirect effects, an individual activity could have undesirable effects. This could include hydrologic changes that might increase erosion or alter habitat conditions, or the alteration or destruction of habitat beneficial for a non-target species.

The proposed Program, as presently designed, does not address the future operations and maintenance needs. Therefore, it is likely that some projects may not have the desired outcomes because future maintenance/operations needs were not anticipated. Some projects may, in fact, result in adverse impacts to fish and wildlife resources, or to other users of the river without periodic maintenance/operation.

The restoration objectives in the proposed plan identified three habitat types for which restoration, enhancement and/or protection projects will be undertaken: terrestrial; wetland; and aquatic.

A. Aquatic Habitat Projects: Embayments

Embayments are essentially the drowned tributary reaches impounded by backwater from the Ohio River. They are natural sediment sinks: as waters coming down the free-flowing tributaries hit the slack water created by impoundment, their sediment load drops out into the basin of the embayment. Over time, many embayments have filled in and become shallower.

A well planned dredging activity will restore deeper water habitats to the embayments, provide a greater buffer range to protect aquatic species from water level fluctuations, aide in protecting spawning areas from desiccation, while providing a variety of habitats and depths that would support the full range of ecosystem components (non-game as well as game fish, and wildlife such as birds, reptiles and amphibians) and allow submerged and emergent aquatic vegetation to be maintained or enhanced.

Potential Impacts/Areas of Concern:

- 👉 Many embayments in the upper Ohio River are obstructed by bridges, culverts, or railroad grades. It may be difficult for heavy equipment to access the area to perform dredging.
- 👉 For many of the embayments, a significant portion of the embayment bottom and the surrounding shoreline area is not publicly owned. Without extensive coordination with

private landowners to insure that access permission is obtained and good public relations are maintained, there may be a lack of public support and cooperation.

- ☝ Generally, lands adjacent to the embayments are privately owned; therefore, dredged material probably cannot be disposed adjacent to the site. An environmentally-acceptable location for dredged material disposal must be located for each project.
- ☝ Unless combined with other activities on a watershed level to address the root cause of sediment load, transport, accumulation and reduced flushing, dredging is only a temporary measure and the embayments will silt in again. If coupled with appropriate runoff and erosion control measures upstream, stream-side conservation easements, riparian restoration etc., to provide a more self-sustaining, stable riparian habitat, these projects will provide more long-term benefits.
- ☝ This activity may also have adverse effects on organisms existing within the current habitats of the embayment. Areas to be dredged should be critically reviewed to select the most appropriate areas.
- ☝ Dredging activities should be conducted in a manner that will not cause excessive turbidity and during seasons that will not cause adverse impacts to fish and wildlife resources.

B. Aquatic/Terrestrial Projects: Islands/Backchannel Habitats

It is expected that projects designed to restore/enhance/protect these habitats will benefit a wide variety of species, as outlined in Section VII. E.

Potential Impacts/Areas of Concern:

- ☝ Without consideration in project design, excavation could cause existing or created slopes to be unstable.
- ☝ Island creation could impact existing habitats including bottomland hardwoods or other high quality areas, either directly or indirectly.
- ☝ Backchannel areas should be maintained to provide a variety of habitats and depths that would support the full range of ecosystem components (non-game as well as game fish, and wildlife such as birds, reptiles and amphibians) and allow submerged and emergent aquatic vegetation to be maintained or enhanced.

C. Aquatic Habitat Projects: In-water Structures

Placement of hard structures within the river will increase habitat diversity. Important habitat attributes such as flow, water depth, and substrate can be altered by placing various structures at strategic locations. Structures typically used to aid in commercial navigation, such as training dikes and bendway weirs, may also be used to improve aquatic habitat for fish and wildlife. Other types of fish and wildlife habitat improvement structures include parallel slab bundle dikes, short emergent spur dikes perpendicular to the shoreline, and parallel rock dikes along the shoreline or in tailwaters. Chevron dikes may also be used to increase in-water habitat diversity as well as to create sandbars for potential least tern nesting habitat.

Potential Impacts/Areas of Concern:

- ☞ If not properly designed, in-water structures could result in adverse changes to hydraulic patterns that might increase erosion and scour, or impair navigation.
- ☞ Depending on construction and depth of each individual project, the structures could present a hazard to navigation unless markers are installed to notify river-users of the structure location.
- ☞ Without adequate consideration for periodic maintenance, some structures may lose their resource benefits and may actually cause adverse environmental impacts.
- ☞ If sites are not carefully selected for structure placement, it could result in loss of existing resources, such as freshwater mussel beds.
- ☞ Without proper design, fish using these areas as current breaks during periods of low water temperature could be displaced by navigation-related changes in current direction/velocity.

D. Wetland/Terrestrial Habitat Projects: Wetlands/Riparian Corridor

In the Ohio River floodplain, a typical habitat structure was a matrix of bottomland forest interspersed with components of other wetland types such as sloughs and oxbows. Much of this habitat has been drained and cleared for agricultural, leaving the remainder highly fragmented; however, several high-quality natural areas remain. Significant wildlife use by wetlands and bottomland forest include the Indiana bat (federally endangered), bald eagle (federally threatened), copperbelly watersnake (federally threatened in the northern part of its range), several state-endangered species, furbearers, waterfowl, colonial wading birds, neotropical migrant songbirds, and a variety of reptiles and amphibians.

Potential Impacts/Areas of Concern: Without proper design and adequate review of project-related direct and indirect effects, funded projects could result in the:

- 👉 conversion of one wetland type to another;
- 👉 loss of rare wetland types and rare plant species; and
- 👉 adverse alteration of drainage patterns

The proposed Program, if successful, would help restore structure and function to the floodplains of the Ohio River and its tributaries. It would help to connect fragmented habitats, thus enlarging the effective sizes of these areas. These activities would benefit a wide variety of species, through creation of habitat and enhancement of water quality, among other benefits.

IX. FISH AND WILDLIFE CONSERVATION MEASURES

This section includes conservation recommendations that, if implemented, would minimize the likelihood of adverse impacts to fish and wildlife resources from site specific habitat restoration, enhancement, and creation activities:

- 👉 Before project design proceeds for activities that involve dredging, the Corps and project sponsor should insure that an environmentally acceptable disposal area is available
- 👉 Whenever possible, projects that involve dredging to remove accumulated sediments should be coupled with appropriate runoff and erosion control measures upstream, stream-side conservation easements, riparian restoration etc., to provide a more self-sustaining, stable riparian habitat.
- 👉 Areas to be dredged should be critically reviewed to avoid adverse effects to non-target species/habitats.
- 👉 Embayments should be maintained to provide a variety of habitats and depths that would support the full range of ecosystem components (non-game as well as game fish, and wildlife such as birds, reptiles and amphibians) and allow submerged and emergent aquatic vegetation to be maintained or enhanced.
- 👉 Dredging activities should be conducted in a manner that will not cause excessive turbidity and during seasons that will not cause adverse impacts to fish and wildlife resources.

- 👍 Ensure that in-water structure design includes consideration of potential changes in hydraulic patterns that might increase erosion and scour, or impair navigation.
- 👍 Any necessary excavation should be designed to ensure that existing or created slopes will be made stable.
- 👍 Island creation may impact existing habitats including bottomland hardwoods or other high quality areas. Project should be designed to avoid adverse secondary impacts to the surrounding project area.

X. SERVICE CONCLUSIONS AND RECOMMENDATIONS: AUTHORIZATION PACKAGE AND PROGRAM IMPLEMENTATION

The Service supports the goals and objective outlined in the plan; that is, the restoration, enhancement and protection of important terrestrial, wetland, and aquatic habitats in and around the Ohio River corridor. With the Ohio River Ecosystem Restoration Project Partnership, assuming that it is designed to be conducive to non-Federal sponsor participation, additional habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources. However, without careful evaluation of proposed site-specific projects for potential secondary or indirect effects, an individual activity could have undesirable effects on fish and wildlife resources.

A. Authorized Project. The Service recommends that the following program design components be included as part of the project submitted to Congress for authorization.

- 👍 The authorization should include direction to the Corps to partner with, at a minimum, the Service and State fish and wildlife agencies to conduct an assessment of the health of the Ohio River system to better define Program goals.
- 👍 The Corps should be directed to collaborate with, at a minimum, the Service and State fish and wildlife agencies to develop quantifiable goals for the restoration program.
- 👍 When developing quantifiable goals, the goals of other ecosystem-based fish and wildlife conservation plans, such as the North American Waterfowl Management Plan, should be incorporated whenever possible.

B. Guidelines/Procedures: The Service recommends that the following guideline/procedures be implemented by the Corps upon Congressional authorization of the Ohio River Ecosystem Restoration Project Partnership.

- 👍 Aquatic ecosystem restoration should focus on restoration of habitat diversity and on habitat/fish passage for species which are endangered, threatened or in serious decline.
- 👍 Terrestrial ecosystems restoration should focus on enhancing habitat diversity, reconnecting fragmented habitats, restoration of riparian areas and habitats for endangered/threatened species, and stabilization of erosion-prone river/stream banks.
- 👍 As conservation planning proceeds for the various studies mentioned in Section III.A.2. above, the Corps should work with the States and the Service to integrate other conservation plans into the plan's goals and in the selection of specific projects for funding.
- 👍 The Corps should partner with the Service, state natural resource agencies and other conservation groups to develop specific management goals for species/habitats of concern. This could be done for the entire mainstem or, for example, each of three sections of the mainstem (upper, middle, lower river) with site-specific areas identified on a pool-by-pool basis.
- 👍 A multi-agency Federal and State natural resources agency team, with perhaps representatives from academia and conservation groups, should be established to: review the Plan and recommend any necessary modification; help set goals; , and review projects submitted to ensure that the projects will help meet the objectives of the Program/plan and that they are environmentally sound.
- 👍 Priority should be placed on projects that require minimal long-term maintenance; provide habitat benefits for a wide variety of species; restores, creates, or enhances historic habitat types that are rare, threatened or declining in abundance; and that can be conducted in conjunction with and/or would compliment efforts from other state, Federal, public or private entities.

In summary, the Service supports the goals and objectives outlined in the plan; that is, the restoration, enhancement and protection of important terrestrial, wetland, and aquatic habitats in and around the Ohio River corridor. With the Ohio River Ecosystem Restoration Project Partnership, assuming that it is designed to be conducive to non-Federal sponsor participation, additional habitat improvements will occur on a significant scale, thus providing an overall benefit for fish and wildlife resources. However, without careful evaluation of proposed site-specific projects for potential undesirable secondary or indirect effects, an individual activity could have undesirable effects.

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APPENDIX A

U.S. ARMY CORPS OF ENGINEERS Ohio River Ecosystem Restoration Partnership Program Ecosystem Restoration Plan

Vision Statement:

The Ohio River is a national treasure, with a rich history of culture, commerce and natural resources, many of which are declining and irreplaceable. The Ohio River Ecosystem Restoration Partnership will restore, enhance, and protect fish and wildlife abundance, diversity and habitats negatively impacted by human activities within the Ohio River watershed."

GOALS: **Restore, enhance and protect wetland habitats along the Ohio River corridor.**
 Restore, enhance and protect important terrestrial habitats adjacent to the Ohio River.
 Restore, enhance and protect aquatic habitats within the Ohio River.

Goal: Restore, enhance and protect wetland habitats along the Ohio River corridor.

Within the Ohio River flood plain and adjacent areas, wetlands have been destroyed and modified, with relatively small, isolated patches of wetlands remaining. Bottomland hardwoods are one of the most critical habitat types within the Ohio River corridor for many species of fish and wildlife, including state and federally endangered species, a number of game species, and commercial fish species. In particular, bottomland hardwoods provide vital habitat for the copperbelly watersnake, a species of concern in IL, IN and KY and to the U.S. Fish and Wildlife Service. Forested, scrub/shrub and emergent wetlands provide indirect benefits to fish and wildlife, and to humans by helping to maintain water quality through filtration and erosion/sediment control.

Objective 1: Forested wetlands: Bottomland hardwoods

- 👉 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection. Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans for each Physiographic Region and Western Hemisphere Shorebird Network management plans, as well as state aquatic management plans, to identify high priority areas and goals for the maintenance and restoration of bottomland hardwoods. Develop and maintain a GIS database for these areas.
- 👉 Protect existing high priority bottomland hardwoods through acquisition, conservation easements and other partnerships with conservation groups, industry, private landowners and citizen watershed groups.

- 👍 Restore bottomland hardwoods in identified high priority areas in partnership with federal and state agencies and private landowners/conservation groups.

Objective 2: Forested Wetlands: Cypress/Tupelo Swamps and Other Unique Forested Wetlands

- 👍 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection. Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans for each Physiographic Region and Western Hemisphere Shorebird Network management plans, as well as state aquatic management plans, to identify high priority areas and goals for the maintenance and restoration of cypress/tupelo swamps and other unique forested habitats.
- 👍 Develop and maintain a GIS database for these areas.
- 👍 Protect existing high priority unique habitats through acquisition, conservation easements and other partnerships with conservation groups, industry private landowners and citizen watershed groups.
- 👍 Restore unique habitats in identified high priority areas in partnership with federal and state agencies and private landowners/conservation groups.

Objective 3: Scrub/Shrub and Emergent Wetlands: isolated (from the river except during high water); and contiguous - (includes scrub/shrub wetlands in embayments and island sloughs)

- 👍 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection. Utilize existing resource management plans such as the North American Waterfowl Management Plan, the Partners in Flight Migratory Bird Action Plans for each Physiographic Region and Western Hemisphere Shorebird Network management plans, as well as state aquatic management plans, to identify high priority areas and goals for the maintenance and restoration of emergent and scrub/shrub wetlands.
- 👍 Develop and maintain a GIS database for these areas.
- 👍 Protect existing high priority scrub/shrub and emergent wetlands through acquisition, conservation easements and other partnerships with conservation groups, industry private landowners and citizen watershed groups.
- 👍 Restore high priority scrub/shrub and emergent wetlands in areas with hydric soils in partnership with federal and state agencies and private landowners/conservation groups.
- 👍 Construct moist soil impoundments in high priority areas that will provide both emergent and submerged aquatic wetlands and exposed mud/sand flats to benefit a wide variety of

species, including waterfowl, shorebirds, copperbelly watersnake and other wildlife species.

- 👍 When designing restoration activities for embayments, maintain a mosaic of habitats to provide not only deepwater refugia for fish species, but also to provide emergent and scrub/shrub wetlands that function as important migratory bird areas, including waterfowl foraging areas, and juvenile fish rearing areas, among other wildlife/fishery values.

GOAL: Restore, enhance and protect important terrestrial habitats adjacent to the Ohio River.

The Ohio River ecosystem was historically a free-flowing river through primarily forested habitat, with scattered prairies, canebrakes and wetlands in the floodplains of the main river and tributaries. Most of this area has been settled, cleared, drained, farmed and developed, resulting in the outright loss of habitat, and the fragmentation of that which remains. Impoundment of the Ohio River has also altered the plant species composition of the riparian corridor. These changes have affected both the abundance and diversity of wildlife, selecting for more generalist species and exacerbating the decline of rare species. The loss of riparian habitat in particular affects not only wildlife but also water quality and quantity in the adjacent waterways. The islands contain some of the more intact riparian and bottomland forest habitats. Impoundment of the river has destroyed the natural process of island creation and accretion, and many islands have been dredged away. There are few lands in the corridor managed with a conservation purpose, and there is a general lack of land use planning and zoning riverwide.

Objective 1: Riparian corridors

- 👍 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them. Develop and maintain a GIS database for these areas.
- 👍 Conduct threat analysis for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, etc.).
- 👍 Work with willing federal, state, local and private partners to restore vegetated riparian corridors riverwide. In particular, reduce fragmentation by expanding and joining isolated blocks, and stabilize eroding banks.

Objective 2: Islands

- 👍 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them. Develop and maintain a GIS database for these areas.

- 👉 Conduct threat analysis for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, etc.).
- 👉 Restore existing islands and/or construct new islands in areas where they historically occurred or where, under current hydrologic conditions, they may be maintained.

Objective 3: Floodplains

- 👉 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them. Develop and maintain a GIS database for these areas.
- 👉 Conduct threat analysis for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats (e.g., erosion control, runoff, drains, etc.).
- 👉 Work with willing federal, state, local and private partners to reforest as much of the floodplain land as possible with native hardwoods, focusing on high priority areas. Reduce forest fragmentation by expanding and joining isolated blocks.

Objective 4: Other Unique Habitats (e.g., canebrakes, river bluffs, etc.)

- 👉 Inventory and identify unique habitats and those areas with the most intact habitat blocks that warrant protection, and work with partners through conservation easements, acquisition, and land use planning to protect them. Develop and maintain a GIS database for these areas.
- 👉 Conduct threat analysis for high priority habitats and work with partners to design and implement measures to eliminate or reduce threats. Restore canebrake habitat as part of the natural mosaic of habitats in the lower half of the Ohio River ecosystem.

GOAL: Restore, enhance and protect aquatic habitats within the Ohio River.

Structure/habitat diversity within the Ohio River is extremely important to all aquatic species and to various species of wildlife using the Ohio River. The Ohio River has been subjected to damming, channel alteration, mining, pollution and an influx of nonnative species such as the zebra mussel. These changes have impacted the diversity and abundance of aquatic species and the distribution and abundance of various wildlife species, including waterfowl, utilizing the Ohio River.

Objective 1: Backwaters (including sloughs, oxbows, embayments and bayous)

- 👉 Inventory and classify backwater areas to identify high priority backwaters that can be restored and/or enhanced to increase habitat for fish and wildlife. Develop and maintain a GIS database for these areas.

- 👍 Restoration/enhancement activities include but are not limited to: addition of structure to increase habitat diversity; dredging to increase deep water habitat or to restore oxbows and sloughs; development of partnerships to decrease sedimentation from upstream land use activities; and, installation of structures to avoid sediment input to certain areas.
- 👍 Identify areas where backwater habitats are limited. Construct backwater areas through the use of off bank revetments, reclamation of abandoned gravel mines, etc.
- 👍 As much as possible, allow snags to remain in these areas.

Objective 2: Riverine submerged and emergent aquatic vegetation

- 👍 Inventory pools on the Ohio River mainstem to identify those pools with the topography and other factors that would allow for establishment of aquatic vegetation beds through environmental pool management.
- 👍 Develop and maintain a GIS database for these areas.
- 👍 Work with the Corps, in concert with other user groups, to develop and implement an environmental pool management strategy for appropriate pools.
- 👍 Identify areas that could support growth of aquatic vegetation with minor modification of flow and/or plantings. Develop and maintain a GIS database for these areas. Install structures to modify flow in those identified areas that would not interfere with other users.

Objective 3: Sand and Gravel Bars

- 👍 Develop and maintain a GIS database of important sand and gravel bar areas for potential protection, restoration, construction, and enhancement activities.
- 👍 Identify and protect sand and gravel bars. Important habitat areas could be protected through the Section 404 and Section 10 permitting process whereby the Corps, States, EPA and FWS would work with the applicant to avoid these important habitat areas. Other protective measures include installation of mooring cells or buoys upstream and downstream of locks and other identified problem areas to relieve emergency or impromptu beaching of tows and barges.
- 👍 Identify high priority areas where sand bars may be enhanced, through the use of dredged material disposal, chevron dikes, or other techniques.
- 👍 Identify high priority areas where gravel bars may be enhanced through the addition of gravel or of structures that would increase scouring of silt from the gravel beds.

- 👍 Identify high priority areas (i.e., less than 9' water depth, adequate current to allow for scouring of sediments and adequate oxygenation) for creation of gravel beds in areas that would not interfere with other uses of the river.

Objective 4: Riffles/Runs (tailwaters)

- 👍 Protect habitats in existing tailwaters.
- 👍 Provide structure such as parallel dikes in tailwaters to increase total surface area and provide refugia for fish.
- 👍 Provide structure, such as parallel dikes, in tailwaters that would decrease dangerous currents in those areas to allow safe access for sport fishing activities.

Objective 5: Pools (deep water; slow velocity; soft substrate)

- 👍 For each pool, identify areas where various structures could be placed that would not conflict with other users, such as the navigation industry. Develop and maintain a GIS database for these areas.
- 👍 Identify partners for construction and placement of these structures and landowners willing to have such structures placed on or adjacent to their properties.
- 👍 Potential habitat diversity structures include: chevron dikes; off-bank revetments; and side channel hard points.
- 👍 As much as possible, allow snags to remain in these areas.

Objective 6: Side channel/back channel habitat

- 👍 Develop and maintain GIS database of side channel/back channel areas for potential protection, restoration, construction, and enhancement activities.
- 👍 Protect and enhance existing islands to protect/enhance the associated back channel habitat. Plantings, hard structures and dredged material disposal are some of the resources that could be used to protect islands.
- 👍 Identify areas where islands previously existed or where new islands could be created to provide valuable back channel habitats without substantial interference with other users. Chevron dikes with dredged material disposal is one method that could be used.
- 👍 Use wing dams and other structures to constrict side channels/back channels to increase velocity and scouring in targeted areas and to provide refugia when needed from the currents.

- 👍 Add additional structure to these areas. Emergent dikes, artificial reef construction, snag placement are some methods of providing structure.
- 👍 As much as possible, allow snags to remain in these areas.

Objective 7: Fish Passage

A number of native riverine fish species may no longer be able to migrate upstream of certain Ohio River dams in numbers sufficient to maintain viable above-dam populations and/or sufficient to meet fish host (reproductive) requirements of certain mussel species.

- 👍 Identify specific dams on the mainstem Ohio River that may be blocking movements of native fish.
- 👍 Identify specific species of fish whose movements may be restricted by any of the dams on the mainstem Ohio River.
- 👍 Test “dummy lockages” and/or other mechanisms to allow movement between navigation pools for target fish species during appropriate seasons.



US Army Corps
of Engineers

Great Lakes And Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT / PITTSBURGH DISTRICT

Ohio River Main Stem Systems Study (ORMSS)

Integrated Decision Document and Environmental Assessment:

Ohio River Ecosystem Restoration Program

Appendix E:

Public Notices, Notice of Intent, Comments



Restore,
Enhance &
Protect
Terrestrial
Habitats in the
Ohio River
Corridor



Restore,
Enhance &
Protect
Wetland
Habitats in
the Ohio
River
Corridor



Restore,
Enhance &
Protect
Aquatic
Habitats in
the Ohio
River
Corridor

DRAFT

August 2000



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix E:

Public Notices, Notices of Intent, Comments

August 2000

Ohio River Ecosystem Restoration Program
ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix E:

**PUBLIC NOTICES, NOTICE OF
INTENT, COMMENTS**

Appendix E:

**PUBLIC NOTICES, NOTICE OF
INTENT, COMMENTS**

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Exhibit E-1 Public Notice dated December 24, 1998

Exhibit E-2 Federal Register Notice October 21, 1998

Exhibit E-3 Federal Register Notice June 9, 2000

Exhibit E-4 Letter dated June 5, 2000 -Ohio River Valley Water Sanitation Commission



**US Army Corps
of Engineers**
Huntington, Louisville, and
Pittsburgh District

Public Notice

Date:

October 30, 1998

Closing Date:

December 24, 1998

Please address all comments and inquiries to:

U.S. Army Corps of Engineers, Huntington District

ATTN: Louis E. Aspey II, CELRH-PD-F

502 Eighth Street

Huntington, West Virginia 25701-2070

Phone: (304) 529-5638

OHIO RIVER MAIN STEM SYSTEMS STUDY PUBLIC AND AGENCY SCOPING MEETINGS

WHO IS INVITED? Agencies and interested individuals who have concerns about the future of navigation improvements and environmental restoration opportunities on the Ohio River Navigation System from Cairo, IL to Pittsburgh, PA.

WHY? The current study is focusing on navigation improvement needs along the entire Ohio River with specific emphasis at John T. Myers, IN and Greenup, KY Locks and Dams, where needs are greatest to relieve congestion. The study team desires your input as alternatives are being formulated, designed, and evaluated in preparation for an Interim Report and Draft EIS to be available for public review in late 1999. Identification of environmental (aquatic and terrestrial) restoration measures for the entire length of the river will also be a part of the effort. These meetings are also being held as part of the requirements for public scoping coordination as part of the National Environmental Policy Act requirements for preparation of an Environmental Impact Statement. A final report to develop additional recommendations for addressing Ohio River navigation needs is scheduled for submission in the year 2002.

WHEN AND WHERE? These meetings will be conducted at the locations and at times indicated below:

November 17, 1998
12:00-8:00 p.m.
Radisson Hotel
600 Walnut Street
Evansville, IN

November 19, 1998
12:00-8:00 p.m.
Huntington Civic Center
Huntington, W. VA,

November 24, 1998
12:00-8:00 p.m.
David L. Lawrence Convention Ctr
Convention Center
Pittsburgh, PA

FORMAT? The meeting will consist of various displays covering the topics of Plan Formulation, Economics, Environmental, and Engineering. Staff will be available at each location to discuss issues, receive comments and suggestions, and answer questions on the study scope.

WHY SHOULD YOU ATTEND? This is your opportunity to provide your views, express your concerns, and to be sure your interests are heard and considered. If you are unable to attend any of the three meetings, please feel free to submit your ideas and thought in writing to: Mr. Louis E. Aspey II, PD-F, Huntington District, U.S. Army Corps of Engineers, 502 Eighth Street, Huntington, West Virginia 25701-2070.

(6) dry panel mining 8 months (approximately March through November).

(7) no action.

3. *Scoping and Public Involvement:* The scoping process will commence in late October 1998 with the issuance of a Scoping Notice. Federal, state and local agencies, Indian tribes, and interested organizations and individuals will be asked to comment on the significant issues relating to the potential effects of the alternatives. A formal public scoping meeting is planned for the evening of November 5, 1998 in Coeur d'Alene, Idaho. An informal open-house will be held the same day in Fernwood, Idaho at Emerald Creek Mining Company headquarters.

Potentially significant issues to be addressed in detail include the effects of the project on wetlands, wildlife and fish, endangered species, cultural resources, recreation, traffic, hazardous materials and waste, and any other issues revealed during the scoping process.

The Draft EIS will be prepared concurrently with other environmental compliance requirements, including the Endangered Species Act and the national Historic Preservation Act. The Corps intends to integrate the consultation procedures pursuant to these other statutes with the EIS. The Corps and the applicant have begun consultation with the United States Fish and Wildlife Service under the Endangered Species Act.

The proposed project also requires a placer mining permit from the State of Idaho Department of Lands as well as a Section 401 Water Quality Certification from the State of Idaho Division of Environmental Quality.

4. *Availability of the Draft EIS:* The Draft EIS is scheduled for release in April 1999.

Gregory D. Showalter,
Army Federal Register Liaison Officer,
[FR Doc. 98-28183 Filed 10-20-98; 8:45 am]
BILLING CODE 3716-00-M

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Notice of Intent to Prepare an Environmental Impact Statement for the Ohio River Main Stem System Study

AGENCY: U.S. Army Corps of Engineers, DOD.

ACTION: Notice.

SUMMARY:

a. The Great Lakes & Ohio River Division of the U.S. Army Corps of Engineers is evaluating alternative investment strategies for the maintenance of commercial navigation infrastructure on the Ohio River System for the next 50 years and for the restoration of habitats along the main stem of the Ohio River that have been degraded by cultural influences. The proposed action is being conducted under the authority of United States Senate, Committee on Public Works resolution dated May 16, 1955; and, United States House of Representatives, Committee on Public Works and Transportation resolution dated March 11, 1982.

b. The Corps of Engineers will conduct public scoping meetings at three locations along the main stem of the Ohio River to solicit input for the development of one or more draft Environmental Impact Statements (EIS) for the project. These meetings will be conducted in an informal setting with "work stations" established for question and answer sessions and the submittal of comments relevant to the format and scope of the EIS. Meetings are scheduled as follows:

Date: November 17, 1998.

Time: 12:00-8:00 pm.

Place: Radisson Hotel, 600 Walnut Street, Evansville, IN. Phone: (800) 333-3333.

Date: November 19, 1998.

Time: 12:00-8:00 pm.

Place: Huntington Civic Arena, PO Box 2767, Huntington, WV. Phone: (304) 696-5990.

Date: November 24, 1998.

Time: 12:00-8:00 pm.

Place: David L. Lawrence Convention Center, 1001 Penn Ave., Pittsburgh, PA. Phone: (412) 565-6000.

Interested parties are encouraged to provide oral comments relevant to the scope of the environmental analysis for the EIS at any of these public forums. Otherwise, please forward written scoping comments or requests for information to the following study contact.

FOR FURTHER INFORMATION CONTACT:

Please address questions regarding this notice to Mr. Louis E. Aspey II, PD-F, Huntington District, Corps of Engineers, 502 Eighth Street, Huntington, West Virginia 25701-2070, Telephone: (304) 529-5638.

SUPPLEMENTARY INFORMATION:

a. The Ohio River Main Stem System Study is designed to capture foreseeable maintenance, rehabilitation and new construction needs for the navigation

infrastructure of the Ohio River until the year 2060 and to investigate habitat restoration options along the main stem Ohio River. The Study would also identify those actions which are economically justified and environmentally prudent. The final report will be advanced during 2002 for approval with implementation planning expected immediately.

b. The Corps of Engineers has been collecting data and pursuing approaches for the study of Ohio River Navigation since 1996. Preliminary economic analysis has indicated traffic congestion and economic losses for two of the nineteen Ohio River Locks & Dams associated with foreseeable maintenance cycles. This has prompted the Corps to pursue an Interim Ohio River Main Stem System Study Report to address this short-term need at Greenup Locks & Dam, Greenup, Kentucky; and John T. Myers Locks & Dam, Mount Vernon, Indiana. This interim report will be advanced in 2000 for approval and requesting authority to implement immediately. Economic losses for both of these structures are associated with future traffic levels being impacted during scheduled maintenance.

c. Feasible approaches to mitigating this economic loss vary with each Lock & Dam facility. However, the Corps has begun the review of small-capital improvements at each site to facilitate lockages using only the existing auxiliary lock chamber during scheduled outages. Extensions to the existing auxiliary chambers and new 1200 foot long lock chambers at the existing sites are also under consideration.

d. Interest in habitat restoration along the main stem of the Ohio River has also prompted consideration of a program to restore degraded habitats as part of a defined restoration program.

e. The EIS will discuss impacts that could occur as a result of construction and operation of the proposed project(s) including impacts to biological resources, cultural resources, and socioeconomic effects, air quality, noise impacts, and recreation resources. The Draft Environmental Impact Statement for the Interim Report is expected to be available to the public in December 1999.

Daniel E. Steiner, P.E.,

Chief, Planning Division.

[FR Doc. 98-28182 Filed 10-20-98; 8:45 am]

BILLING CODE 3716-05-M

(which was so confusing and impractical that the cited letter has to be written to interpret it) was changed because it: (a) is not feasible in a non-paper environment, (b) does not correspond to commercial practice of using a GMC as the sole arbiter of mileage, and (c) resulted in an unrealistic administrative burden calculating and reconciling mileages in each and every state through which a shipment passed, and typically involved adding mileages from one state line to the next.

Comment: Towaway Service (Item 228) This new Item does not fairly divide liability issues between shipper and carrier; instead all liabilities are imposed on the carrier.

Response: We have adopted the language "or other failure to properly maintain * * *". We have considered the additional request that DoD assume liability, including attorney fees, for third-party claims resulting from Towaway Service. We cannot assume this liability and do not believe that it would be equitable to do so. Each claim, if any, would have to be decided on a case-by-case basis.

Comment: Weight Verification (Item 250).

Response: There has been no substantive change from the 1A to the 1B.

Comment: Dromedary Services (old Items 325 and 327). Why are these Items eliminated? While much of the information has been incorporated elsewhere (e.g. Item 105), some essential information appears nowhere in the 1B. 5000 and 10000 pound minimum charges for regular and 410 dromedary shipments, respectively, have been eliminated for Dual Driver and Protective Security accessories, and for White Phosphorus and similar commodities.

Response: These provisions have not been eliminated for the two accessories cited: the 1B includes them in Item 35, para 1a, Item 40, para 2b, and Item 105, para c. The provisions for white phosphorus and similar commodities have been restored, and now appear in Item 328, paragraph 2.

Regulatory Flexibility Act: This change is not considered rule making within the meaning of the Regulatory Flexibility Act, 5 U.S.C. 601-612.

Paperwork Reduction Act: The Paperwork Reduction Act, 44 U.S.C. 3031 et seq., does not apply because no information collection requirement or recordkeeping responsibilities are

imposed on offerors, contractors, or members of the public.

Thomas Hicks,
Deputy Chief of Staff for Operations.
[FR Doc. 00-14677 Filed 6-8-00; 8:45 am]
BILLING CODE 3710-08-U

DEPARTMENT OF DEFENSE

Corps of Engineers, Department of the Army

Notice of Intent To Prepare an Environmental Assessment for Proposed Authorization of an Ohio River Ecosystem Restoration Program

AGENCY: U.S. Army Corps of Engineers, DoD.

ACTION: Notice.

SUMMARY: This Notice of Intent is an amendment to the Department of the Army, Corps of Engineers, "Notice of Intent to Prepare an Environmental Impact Statement for the Ohio River Main Stem System Study," published in *Federal Register*, volume 63, number 203 page 56165, on Wednesday, October 21, 1998.

The U.S. Army Corps of Engineers, in partnership with the U.S. Fish and Wildlife Service, and resource agencies of states bordering the Ohio River, is currently evaluating various ecosystem restoration opportunities for the Ohio River corridor. The proposed action is being conducted under the authority of United States Senate, Committee on Public Works resolution dated May 16, 1955; and, United States House of Representatives, Committee on Public Works and Transportation resolution dated March 11, 1982.

The Corps of Engineers will prepare and circulate a Decision Document and integrated Environmental Assessment which will announce an intention to prepare a Finding of No Significant Impact (FONSI), if appropriate. Public review of this report is scheduled to begin in July 2000. Interested parties are encouraged to send written comments or requests for information, regarding the proposed study process, to the point-of-contact below. All comments and information requests should be postmarked no later than 30 days after this Notice of Intent is published.

FOR FURTHER INFORMATION CONTACT: Please address questions regarding this notice to Mr. Michael Q. Holley, PM-C, Louisville District, Corps of Engineers, P.O. Box 59, Louisville, Kentucky 40201-0059, Telephone: (502) 582-5152.

SUPPLEMENTARY INFORMATION:

a. Reference *Federal Register*, volume 63, number 203, dated Wednesday, October 21, 1998. Within that document, the Corps of Engineers gave notice of intent to prepare an Environmental Impact Statement for the Ohio River Main Stem System Study.

This study is designed to capture foreseeable maintenance, rehabilitation and new construction needs for the navigation infrastructure of the Ohio River until the year 2060 and to investigate habitat restoration options along the main stem Ohio River. The study would also identify those actions which are economically justified and environmentally prudent.

b. As part of the Ohio River Main Stem System Study, an environmental team, consisting of personnel from the U.S. Fish and Wildlife Service, the natural resource agencies of six states, and the Corps of Engineers was formed. This team investigated opportunities and established general goals for ecosystem restoration projects. During the initial study process, resource officials of states bordering the Ohio River, identified over 250 site-specific environmental projects for further analysis. Because of the considerable interest, the Corps of Engineers, with support from state officials, initiated a study report for proposed authorization of a cost shared ecosystem restoration program for the Ohio River.

c. The Corps of Engineers originally intended to study ecosystem restoration, within the entire Ohio River Main Stem System Study, as indicated in the Supplemental Information of *Federal Register*, volume 63, number 203. However, an ecosystem restoration program does not relate directly to navigational improvements and can stand independent of those improvements. It was therefore determined that an ecosystem restoration program would be developed as a separate product of the Ohio River Main Stem System Study.

d. The primary purpose of the proposed ecosystem restoration program is to restore and protect aquatic, wetland, floodplain and riparian habitats that would benefit from such a program for the Ohio River watershed. These goals would be accomplished by means of erosion control, island restoration, bottomland reforestation, creation of aquatic habitat, and other generally accepted environmental measures. As a secondary objective, the program would preserve the historic and cultural resources of the Ohio River through implementation of various low cost educational and recreational amenities that would not detract from

the environmental restoration goals of the program.

e. The Corps of Engineers will prepare and circulate a Decision Document and integrated Environmental Assessment which will announce an intention to prepare a FONSI if a FONSI is determined to be appropriate.

Circulation of this document will assist the Corps in determining whether an Environmental Impact Statement (EIS) or a FONSI is the next appropriate step in the NEPA process prior to authorization of a cost shared ecosystem restoration program for the Ohio River.

Daniel E. Steiner,
Chief, Planning Division.

[FR Doc. 00-14676 Filed 6-8-00; 8:45 am]

BILLING CODE 3710-85-M

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Announcement of Army Corps of Engineers Regional Listening Sessions

AGENCY: Corps of Engineers, DoD.

ACTION: Notice correction.

SUMMARY: In a previous Federal Register notice (65 FR 34453), Tuesday, May 30, 2000, an incorrect phone number was inadvertently provided on page 34454, column 1, line 12. The correct phone number for local calls in Northern Virginia area is (703) 428-8535.

FOR FURTHER INFORMATION CONTACT: Mr. Mark Gmitro, Program Manager, phone toll free (877) 447-6342 or if you're in the Northern Virginia area, please refer to the correct phone number as listed above.

SUPPLEMENTARY INFORMATION: None.

John A. Hall,

Alternate Army Federal Register Liaison Officer.

[FR Doc. 00-14675 Filed 6-8-00; 8:45 am]

BILLING CODE 3710-92-M

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Availability of Inventions for Licensing; Government-Owned Inventions

AGENCY: Department of the Navy, DOD.

ACTION: Notice.

SUMMARY: The invention listed below is assigned to the United States Government as represented by the

Secretary of the Navy and are available for licensing by the Department of Navy.

U.S. Patent Application Serial No. 09/551,364 entitled, "Collaborative Development Network for Widely Dispersed Users and Methods Therefor," filing date: April 17, 2000, Navy Case No. 79260.

ADDRESS: Requests for copies of the patent application cited should be directed to the Naval Surface Warfare Center, Dahlgren Laboratory, Code CD222, 17320 Dahlgren Road, Building 183, Room 015, Dahlgren, VA 22448-5100, and must include the Navy Case number. Interested parties will be required to sign a Confidentiality, Non-Disclosure and Non-Use Agreement before receiving copies of requested patent applications.

FOR FURTHER INFORMATION CONTACT: James B. Bechtel, Patent Counsel, Naval Surface Warfare Center, Dahlgren Laboratory, Code CD222, 17320 Dahlgren Road, Building 183, Room 015, Dahlgren, VA 22448-5100, telephone (540) 653-8016.

(Authority: 35 U.S.C. 207, 37 CFR Part 404)

Dated: May 31, 2000,

J.L. Roth,

Lieutenant Commander, Judge Advocate General's Corps, U.S. Navy, Federal Register Liaison Officer.

[FR Doc. 00-14640 Filed 6-8-00; 8:45 am]

BILLING CODE 3010-FF-U

DEPARTMENT OF EDUCATION

Notice of Proposed Information Collection Requests

AGENCY: Department of Education.

SUMMARY: The Leader, Regulatory Information Management, Office of the Chief Information Officer, invites comments on the proposed information collection requests as required by the Paperwork Reduction Act of 1995.

DATES: Interested persons are invited to submit comments on or before August 8, 2000.

SUPPLEMENTARY INFORMATION: Section 3506 of the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires that the Office of Management and Budget (OMB) provide interested Federal agencies and the public an early opportunity to comment on information collection requests. OMB may amend or waive the requirement for public consultation to the extent that public participation in the approval process would defeat the purpose of the information collection, violate State or Federal law, or substantially interfere with any agency's ability to perform its

statutory obligations. The Leader, Regulatory Information Management, Office of the Chief Information Officer, publishes that notice containing proposed information collection requests prior to submission of these requests to OMB. Each proposed information collection, grouped by office, contains the following: (1) Type of review requested, e.g. new, revision, extension, existing or reinstatement; (2) Title; (3) Summary of the collection; (4) Description of the need for, and proposed use of, the information; (5) Respondents and frequency of collection; and (6) Reporting and/or Recordkeeping burden. OMB invites public comment. The Department of Education is especially interested in public comment addressing the following issues: (1) Is this collection necessary to the proper functions of the Department? (2) Will this information be processed and used in a timely manner; (3) Is the estimate of burden accurate; (4) How might the Department enhance the quality, utility, and clarity of the information to be collected; and (5) How might the Department minimize the burden of this collection on the respondents, including through the use of information technology.

Dated: June 5, 2000,

John Tressler,

Leader, Regulatory Information Management, Office of the Chief Information Officer.

Office of Special Education and Rehabilitative Services

Type of Review: New.

Title: National Longitudinal Transition Study-2.

Frequency: One time.

Affected Public: Businesses or other for-profit; Not-for-profit institutions; State, Local, or Tribal Gov't, SEAs or LEAs.

Reporting and Recordkeeping Hour Burden:

Responses: 432.

Burden Hours: 354.

Abstract: NLTS2 will provide nationally representative information about youth with disabilities in secondary school and in transition to adult life, including their characteristics, programs and services, and achievements in multiple domains (e.g., postsecondary education, employment).

Requests for copies of the proposed information collection request may be accessed from <http://edicsweb.ed.gov>, or should be addressed to Vivian Reese, Department of Education, 400 Maryland Avenue, SW, Room 5624, Regional Office Building 3, Washington, DC 20202-4651. Requests may also be



OHIO RIVER VALLEY
WATER SANITATION COMMISSION

3738 KELLOGG AVENUE, CINCINNATI, OHIO 45228-1112 (513) 231-7719 FAX (513) 231-7761

ROY W. MUNDY
CHAIRMAN
ALAN H. VICORY, JR., P.E., DEE
EXECUTIVE DIRECTOR
AND CHIEF ENGINEER

June 5, 2000

Brigadier General Robert H. Griffin
U.S. Army Corps of Engineers
P.O. Box 1159
Cincinnati, OH 45201-2259

Dear General Griffin:

First, permit me to supplement the words of ORSANCO Chairman Roy Mundy, in his letter to you of May 11, by noting my own appreciation for your time in our office this past April 21st. I trust our staff presentation on the concepts regarding biological indices and how such an index for the Ohio River might serve the management analysis efforts of the Corps, was enlightening. I want to confirm ORSANCO's commitment to the project and desire to make this a joint effort with the Corps.

This letter also provides me the opportunity to enclose a resolution in support of the Corps' Ohio River Ecological Restoration Program that was adopted at the Commission's 167th Meeting held on May 25th in Lexington, KY. In that resolution, the Commission notes the complimentary nature of the Ecological Restoration Program and the use of a bioindex to measure its effectiveness. The Commission is hopeful its support might facilitate your efforts to make the Restoration Program a reality.

We certainly hope the emerging partnership between the Corps and ORSANCO will be just the beginning and that additional joint objective will be identified and pursued.

Again, our thanks.

Sincerely,

Alan H. Vicory, Jr.

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OHIO RIVER VALLEY
WATER SANITATION COMMISSION

3735 KELLOGG AVENUE, CINCINNATI, OHIO 45226-1112 (513) 231-7719 FAX: (513) 231-7761

RESOLUTION 2-00

Expressing the Ohio River Valley Water Sanitation Commission's Support for the Corps of Engineer's Ohio River Ecological Restoration Program,

NOW, THEREFORE, BE IT RESOLVED: That the Ohio River Valley Water Sanitation Commission affirms its support of the Ohio River Ecological Restoration Program and offers its assistance, where appropriate and possible, to facilitate its execution;

BE IT FURTHER RESOLVED: That this Commission acknowledges the complimentary nature of this Program and efforts to develop Ohio River Biological Indices and Biocriteria. As such, each program should maintain close communications and connections.



Adopted by action of the Commissioners of the
Ohio River Valley Water Sanitation Commission
on this, the 25th day of May, 2000.



Roy W. Mundy II, Chairman

An interstate agency representing: Illinois • Indiana • Kentucky • New York • Ohio • Pennsylvania • Virginia • West Virginia
An Equal Employment Opportunity Employer



US Army Corps
of Engineers

Great Lakes And Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT / PITTSBURGH DISTRICT

Ohio River Main Stem Systems Study (ORMSS)

Integrated Decision Document and Environmental Assessment:

Ohio River Ecosystem Restoration Program

Appendix F:

Nonfederal Cooperation



Restore,
Enhance &
Protect
Terrestrial
Habitats in
the Ohio
River Corridor



Restore,
Enhance &
Protect
Wetland
Habitats in
the Ohio
River
Corridor



Restore,
Enhance &
Protect
Aquatic
Habitats in
the Ohio
River
Corridor

DRAFT

August 2000



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

Integrated Decision Document and Environmental Assessment :

Ohio River Ecosystem Restoration Program ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix F:

Nonfederal Cooperation

August 2000

Ohio River Ecosystem Restoration Program
ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA

Appendix F:
NONFEDERAL COOPERATION

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Exhibit F-2	Letter of Intent dated March 8, 2000 Kentucky Department of Fish and Wildlife Resources
Exhibit F-3	West Virginia Division of Natural Resources
Exhibit F-4	Ohio Department of Natural Resources
Exhibit F-5	Ohio River Valley Water Sanitation Commission.



Indiana Department of Natural Resources

Frank O'Bannon, Governor
Larry D. Macklin, Director

Executive Office
402 W. Washington Street W 256
Indianapolis, IN 46204-2748

March 14, 2000

Robert H. Griffin
Brigadier General, U.S. Army
Great Lakes and Ohio River Division
P.O. Box 1159
Cincinnati, OH 45201-1159

Dear General Griffin:

The Indiana Department of Natural Resources (DNR) writes this letter to express our intent to participate in the Ecosystem Restoration Program. The Corps of Engineers is studying this program as a part of the Ohio River Main Stem Navigation Study.

Our department has coordinated with the Louisville District for several years regarding the Ohio River Main Stem Navigation Study. Together, our agencies have identified over one hundred projects within Indiana for consideration as part of an ecosystem restoration program for the Ohio River. The Corps has developed a concept level cost estimate for twenty-five of these projects and a detailed analysis of our agency's three highest priority sites as part of the ongoing feasibility study. The Indiana DNR is interested in participating in this effort and receiving full credit for our work towards implementation of our three feasibility level Ohio River ecosystem restoration projects for the State of Indiana.

We understand that a formal cost sharing agreement between the Corps and a non-federal entity such as the Indiana Department of Natural Resources will be required for each project constructed under this program. Although nationwide programs with similar environmental improvement purposes currently exist, we believe that funding would be easier to obtain for individual projects at the state and federal level if a program specific to the Ohio River were established. Such a program would facilitate more efficient coordination and scheduling between state and federal levels, particularly in regard to budgeting future funds for ecosystem restoration projects. We are also aware that participation in such a program will require obligations, similar to those of the 1135 and 206 programs, for lands, easements, rights-of-way, relocations, and dredged or excavated disposal areas (LERRD), and for operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of project features. Our agency has the ability and willingness to meet these requirements. These projects would also be subject to all applicable state and federal laws and regulations.

The Indiana Department of Natural Resources believes that non-federal sponsors should have more favorable cost sharing and work-in-kind credit arrangements than those that are currently allowed. This is due to several reasons including the anticipated long-term project costs to be funded by the non-federal sponsor. To our understanding these changes will require the incorporation of appropriate provisions within the legislative framework for the Ecosystem Restoration Program. We further understand that this letter does not commit the Indiana Department of Natural Resources to any costs at this time. It does indicate that we support the Ecosystem Restoration Program, and that we intend to participate in the program if acceptable cost sharing and work-in-kind credit arrangements are enacted.

Sincerely,

Larry D. Macklin, Director

LDM:WRM

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FISH & WILDLIFE COMMISSION

Mike Boatwright, Paducah
Tom Baker, Bowling Green
Allen K. Gailor, Louisville
Charles E. Hale, Hodgenville
James R. Rich, Taylor Mill
Frank Brown, Richmond
ig Hensley, Hazard
Robert C. Webb, Grayson
David H. Godby, Somerset



COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH AND WILDLIFE RESOURCES
C. THOMAS BENNETT, COMMISSIONER

March 8, 2000

Robert H. Griffin
Brigadier General, U.S. Army
Great Lakes and Ohio River Division
PO Box 1159
Cincinnati, Ohio 45201-1159

Dear General Griffin:

This letter is to express our intent to participate in the Ecosystem Restoration program that the Corps of Engineers is studying as a part of the Ohio River Main Stem Navigation Study.

Working with the Corps since 1996, the States bordering the Ohio River have identified over 260 sites for consideration as a part of an ecosystem restoration program for the Ohio River. We have also worked with the Corps to develop a concept level cost estimate for all 260 projects and a detailed analysis of each state's 3 highest priority sites as part of the ongoing feasibility study. We are interested in participating in this effort and receiving full credit for our work towards implementation of our top three Ohio River ecosystem restoration projects for the State of Kentucky.

We understand that a formal cost sharing agreement, between the Corps and a non-Federal entity such as the State of Kentucky, will be required for each project constructed under this program. Although nationwide programs with similar environmental improvement purposes currently exist, we believe that funding would be easier to obtain for individual projects at the State and Federal level if a program specific to the Ohio River were established. Such a program would facilitate more efficient coordination and scheduling between the Federal and State levels, particularly in regard to budgeting future funds for ecosystem restoration projects. We are also aware that participation in such a program will require obligations, similar to those of the 1135 and 206 programs, for lands, easements, rights-of-way, relocations, and dredged or excavated disposal areas (LERRD), and operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of project features. The State of Kentucky is able and willing to meet these requirements.

We believe the non-Federal sponsor should have more favorable cost sharing and work-in-kind credit arrangements, than currently allowed, because of anticipated long-term project costs to be funded by the non-Federal sponsor. These changes will require the incorporation of appropriate provisions within the



Arnold L. Mitchell Bldg. #1 Game Farm Road Frankfort, Ky 40601
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Page Two
General Griffin
Letter of Intent for Ohio River
Ecosystem Restoration Program
March 8, 2000

legislative framework for the Ecosystem Restoration Program. This letter does not commit the State of Kentucky to any costs at this time. It does show that we support the Ecosystem Restoration Program, and that we intend to participate in the program if acceptable cost sharing and work-in-kind credit arrangements are enacted.

Sincerely,

A handwritten signature in black ink, appearing to read "C. Thomas Bennett". The signature is stylized with a large, sweeping "C" and a long horizontal stroke extending to the right.

C. Thomas Bennett, Commissioner
Department of Fish and Wildlife Resources

CTB/PWP/kh

cc: Tom Young, Deputy Commissioner
Ted Crowell, Assistant Director, Fisheries
Benjy Kinman, Fisheries
Jim Axon, Fisheries
Wayne Davis, Fisheries
Doug Henley, Fisheries



DIVISION OF NATURAL RESOURCES

Wildlife Resources Section
Capitol Complex, Building 3, Room 812
1900 Kanawha Boulevard, East
Charleston, WV 25306-0664
Telephone (304) 558-2771
Fax (304) 558-3147
TDD 1-800-354-6087

Cecil H. Underwood
Governor

John B. Rader
Director

March 21, 2000

Robert H. Griffin
Brigadier General, U.S. Army
Great Lakes and Ohio River Division
P. O. Box 1159
Cincinnati, OH 45201-1159

Dear General Griffin:

This letter is to express our intent to participate in the Ecosystem Restoration Program that the Corps of Engineers is studying as a part of the Ohio River Main Stem Navigation Study.

Working with the Corps since 1996, the States bordering the Ohio River have identified over 260 sites for consideration as a part of an ecosystem restoration program for the Ohio River. We have also worked with the Corps to develop a concept level cost estimate for all 260 projects and a detailed analysis of each state's three highest priority sites as part of the ongoing feasibility study. We are interested in participating in this effort and receiving full credit for our work towards implementation of the three Ohio River ecosystem restoration projects in West Virginia.

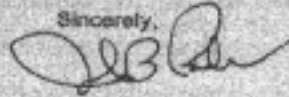
We understand that a formal cost sharing agreement, between the Corps and a non-Federal entity, will be required for each project constructed under this program. Although nationwide programs with similar environmental improvement purposes currently exist, we believe that funding would be easier to obtain for individual projects at the State and Federal level if a program specific to the Ohio River were established. Such a program would facilitate more efficient coordination and scheduling between the Federal and State levels, particularly in regard to budgeting future funds for ecosystem restoration projects. We are also aware that participation in such a program will require obligations, similar to those of the 1135 and 206 programs, for lands, easements, rights-of-way, relocations, and dredged or excavated disposal areas (LERRD), and operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of project features.

We believe the non-Federal sponsor should have more favorable cost sharing and work-in-kind credit arrangements, than currently allowed, because of anticipated long-term project costs to be funded by the non-Federal sponsor. These changes will require the incorporation of appropriate provisions within the legislative framework for the Ecosystem Restoration Program.

General Robert H. Griffin
March 21, 2000
Page 2

This letter does not commit the State of West Virginia to any costs at this time. It does show that we support the Ecosystem Restoration Program, and that we intend to participate in the program if acceptable cost sharing and work-in-kind credit arrangements are enacted.

Sincerely,

A handwritten signature in dark ink, appearing to read "JBR", with a stylized flourish extending from the end.

John B. Rader
Director

JBR/bpq



Ohio Department of Natural Resources

BOB TAFT, GOVERNOR

SAMUEL W. SPECK, DIRECTOR

Office of the Director
1930 Belcher Drive – Bldg. D-3
Columbus, OH 43224-1387

Phone: (614) 265-6879 Fax: (614) 261-9601

June 7, 2000

Robert H. Griffin
Brigadier General, U.S. Army
Great Lakes and Ohio River Division
P.O. Box 1159
Cincinnati, OH 45201-1159

Dear General Griffin:

This letter is to express our intent to participate in the Ecosystem Restoration Program that the Corps of Engineers is studying as a part of the Ohio River Main Stem Navigation Study.

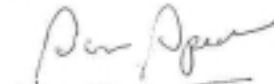
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We understand that a formal cost sharing agreement between the Corps and a non-Federal entity such as the State of Ohio will be required for each project constructed under this program. Although nationwide programs with similar environmental improvement purposes currently exist, we believe that funding would be easier to obtain for individual projects at the State and Federal level if a program specific to the Ohio River were established. Such a program would facilitate more efficient coordination and scheduling between the Federal and State levels, particularly in regard to budgeting future funds for ecosystem restoration projects. We are also aware that participation in such a program will require obligations, similar to those of the 1135 and 206 programs, for lands, easements, rights-of-way, relocations, and dredged or excavated disposal areas (LERRD), and operation maintenance, repair rehabilitation, and replacement (OMRR&R) of project features. The State of Ohio is able and willing to meet those requirements.

Robert H. Griffin
June 7, 2000
Page Two

We believe the non-Federal sponsor should have more favorable cost sharing and work-in-kind credit arrangements than currently allowed, because of anticipated long-term project costs to be funded by the non-Federal sponsor. These changes will require the incorporation of appropriate provisions within the legislative framework for the Ecosystem Restoration Program. This letter does not commit the State of Ohio to any costs at this time. It does show that we support the Ecosystem Restoration Program, and that we intend to participate in the program if acceptable cost sharing and work-in-kind credit arrangements are enacted.

Sincerely,



Samuel W. Speck
Director

SWS/sb



OHIO RIVER VALLEY
WATER SANITATION COMMISSION

3738 KELLOGG AVENUE, CINCINNATI, OHIO 45228-1112 (612) 231-7710 FAX (513) 231-7701

ROY W. MUNDY
CHAIRMAN
ALAN H. VICORY, JR., P.E., DEE
EXECUTIVE DIRECTOR
AND CHIEF ENGINEER

June 5, 2000

Brigadier General Robert H. Griffin
U.S. Army Corps of Engineers
P.O. Box 1159
Cincinnati, OH 45201-2259

Dear General Griffin:

First, permit me to supplement the words of ORSANCO Chairman Roy Mundy, in his letter to you of May 11, by noting my own appreciation for your time in our office this past April 21st. I trust our staff presentation on the concepts regarding biological indices and how such an index for the Ohio River might serve the management analysis efforts of the Corps, was enlightening. I want to confirm ORSANCO's commitment to the project and desire to make this a joint effort with the Corps.

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We certainly hope the emerging partnership between the Corps and ORSANCO will be just the beginning and that additional joint objective will be identified and pursued.

Again, our thanks.

Sincerely,

Alan H. Vicory, Jr.

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OHIO RIVER VALLEY
WATER SANITATION COMMISSION

3735 KELLOGG AVENUE, CINCINNATI, OHIO 45226-1112 (513) 231-7719 FAX: (513) 231-7761

RESOLUTION 2-00

Expressing the Ohio River Valley Water Sanitation Commission's Support for the Corps of Engineer's Ohio River Ecological Restoration Program,

NOW, THEREFORE, BE IT RESOLVED: That the Ohio River Valley Water Sanitation Commission affirms its support of the Ohio River Ecological Restoration Program and offers its assistance, where appropriate and possible, to facilitate its execution;

BE IT FURTHER RESOLVED: That this Commission acknowledges the complimentary nature of this Program and efforts to develop Ohio River Biological Indices and Biocriteria. As such, each program should maintain close communications and connections.



Adopted by action of the Commissioners of the
Ohio River Valley Water Sanitation Commission
on this, the 25th day of May, 2000.



Roy W. Mundy II, Chairman

An interstate agency representing: Illinois • Indiana • Kentucky • New York • Ohio • Pennsylvania • Virginia • West Virginia
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